


BASIC FTBALL and Computer Programming for All

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Abstract

In late fall 1965, John Kemeny wrote a 239-line BASIC program called FTBALL^{***}. Along with his colleague Thomas Kurtz and a few work-study students at Dartmouth College, Kemeny had developed the BASIC programming language and Dartmouth Time-Sharing System (DTSS). BASIC and DTSS represented perhaps the earliest successful attempt at “computer programming for all,” combining English-language vocabulary, simple yet robust instructions, and near-realtime access to a mainframe computer. This article takes a closer look at FTBALL as a crucial program in the history of “programming for all” while gesturing to the tension between a conception of “all” and FTBALL’s context in an elite, all-male college in the mid-1960s. I put FTBALL in a historical, cultural, gendered context of “programming for all” as well as the historical context of programming language development, timesharing technology, and the hardware and financial arrangements necessary to support this kind of playful, interactive program in 1965. I begin with a short history of BASIC’s early development, compare FTBALL with other early games and sports games, then move into the hardware and technical details that enabled the code before finally reading FTBALL’s code in detail. Using methods from critical code studies (Marino 2020), I point to specific innovations of BASIC at the time and outline the program flow of FTBALL. This history and code reading of BASIC FTBALL provides something of interest to computing historians, critical code studies practitioners, and games scholars and aficionados.

In late fall 1965, John Kemeny wrote a 239-line BASIC program called FTBALL^{***}. Along with his colleague Thomas Kurtz and a few work-study students at Dartmouth College, Kemeny had developed the BASIC programming language and Dartmouth Time-Sharing System (DTSS), both of which went live on May 1, 1964. BASIC and DTSS represented perhaps the earliest successful attempt at “programming for all,” combining English-language vocabulary (e.g., HELLO instead of LOGON), simple yet robust instructions, and near-realtime access to a mainframe computer. Their efforts were funded by the National Science Foundation and buoyed by their ingenuity and that of undergraduates invested in the project. Beginning in 1966, Kemeny and Kurtz rolled out an ambitious training course that, over the next few years, taught about 80% of Dartmouth students and faculty how to program in BASIC in just a couple of hours. From the mid-1960s on, they facilitated connections to the Dartmouth computing network from local high schools and other colleges, making the computer and BASIC accessible beyond undergraduates at Dartmouth. Their free licensing of BASIC eventually led to a splintering of hundreds of versions of the language by the 1970s and ‘80s, one of which was famously written by Bill Gates and Paul Allen and helped to launch Microsoft, and another of which (less famously) introduced me to programming on my Commodore 64 in 1982. My own introduction to programming in the early 1980s was part of a larger movement of “computer programming for all” in the 1980s, associated with computer literacy campaigns and renewed emphases on educational technology in the Cold War. But Kemeny and Kurtz got there first in the 1960s at Dartmouth.

FTBALL is a great example of 1960s BASIC programming, but its cultural significance is as a deliberate demonstration of computers as *fun*. Preceded by games such as *Tennis for Two* and *Spacewar!*, FTBALL was part of an approach to computing that ran counter to the more dominant applications of defense and the hard sciences at the time. FTBALL’s author, John Kemeny, was a math professor at Dartmouth, as well as a former assistant to Albert Einstein at Princeton’s Institute for Advanced Study and, later, President of Dartmouth College — a position in which he led admissions for

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women and the recruitment of Native American students. Along with his collaborator Thomas Kurtz, Kemeny believed computers could be fun and should be widely accessible to a general population of students. In the final report on an NSF grant Kemeny and Kurtz received for their BASIC timesharing project, they write:

A remark is in order concerning the use of computers to play games. They are a magnificent means of recreation. But people feel that it is frivolous to use these giants to play games. We do not share this prejudice. There is no better way of destroying fear of machines than to have the novice play a few games with the computer. We have noted this phenomenon several times, particularly with our visiting alumni. And most of the games have been programmed by our students, which is an excellent way to learn programming. [Kemeny and Kurtz 1967 (a)]

Indeed, from its outset and original design, the BASIC lab at Dartmouth and the BASIC programming language fostered programming games as a way to learn about computing. Kemeny and Kurtz encouraged students to add to their libraries of BASIC programs, and in the 1970s, publications of BASIC games in the book *BASIC Computer Games* by David Ahl and in popular computer magazines further supported learning programming through games. 3

This article takes a closer look at FTBALL as a crucial program in the history of “computer programming for all” while gesturing to the tension between a conception of *all* and FTBALL’s context in an elite, all-male college in the mid-1960s. FTBALL can be seen as an early indicator of masculine computing culture (see [Rankin 2018], [Ensmenger 2012]) and a product of American college football culture, areas where women have played a peripheral but ever-present role. But FTBALL is *also* an early example of computing for undergraduates, for people outside the hard sciences, and for fun. That a renowned professor wrote it to be played for free by undergraduates at a time when computers were generally reserved for “serious” work in calculation makes it an excellent object of study for the history of BASIC, early computing education, and accessible programming more generally. Accordingly, I put FTBALL in a historical, cultural, gendered context of “programming for all” as well as the historical context of programming language development, timesharing technology, and the hardware and financial arrangements necessary to support this kind of playful, interactive program in 1965. 4

Using methods from critical code studies [Marino 2020], I point to specific innovations of BASIC at the time and outline the program flow of FTBALL. FTBALL demonstrates a number of features typical of early BASIC that were innovative for the time, including `LET` as an assignment statement and the infamous `GOTO` and `GOSUB` statements for program flow. The `GOTO` and `GOSUB` statements make FTBALL’s program flow difficult to follow — which is also typical for more complex, early BASIC programs. The convolution of program flow in FTBALL is both ironic and predictable, given FTBALL’s popularity and attempt at accessibility alongside the common critiques of early BASIC program structures. Adding to the code analysis in this article, I use methods from history of computing, drawing historical context from archival records held by Dartmouth College Libraries, BASIC fan sites, a 2014 Dartmouth documentary titled *Birth of Basic*, Joy Lisi Rankin’s *A People’s History of Computing*, the collaboratively authored book *10 PRINT*, contemporary BASIC programming manuals, and a personal interview I conducted with Thomas Kurtz in 2017.^[1] 5

My combined code analysis and archival approach for FTBALL follows in the footsteps of Dennis Jerz’s examination of Will Crowther’s *Colossal Cave Adventure* (an early text adventure game from the 1970s) and Nick Montfort’s work on “Zork” (a game inspired by *Adventure*) in *Twisty Little Passages*. While FTBALL is often credited for its early influence on sports games and its later variations are noted as popular BASIC games, it has received little scholarly attention and, to my knowledge, no attention to the composition of its code nor its early role in popularizing BASIC. As with *Adventure* and *Zork*, the availability of FTBALL’s code and its textual interface makes it rich for textual analysis. The popularity of all three games as early genre entries justifies the extended attention to their cultural and historical contexts as well. Below, I begin with a short history of BASIC’s early development, put FTBALL in context with other early games and sports games, then move into the hardware and technical details that enabled the code before finally reading FTBALL’s code in detail. My hope is to provide something of interest to computing historians, critical code studies practitioners, and games scholars and aficionados. 6

BASIC and Accessible Computing at Dartmouth

With the skills and needs of liberal arts students at Dartmouth in mind, math professors John Kemeny and Thomas Kurtz began in the 1950s to work towards an ambitious goal of teaching the entire undergraduate population of Dartmouth basic computer literacy. They had begun this project by working closely with students to develop simplified assembly code. During the early 1960s, they moved through several languages and hardware setups prior to requesting funds from the NSF and the college for a hardware system that would support their pedagogical goals. With this support and the ingenuity of undergraduate collaborators, in 1964, Kemeny and Kurtz launched the BASIC language and the Dartmouth Time-Sharing System (DTSS). BASIC went through several rapid revisions in the mid-1960s, and then spread widely due to its accessible syntax, generous licensing, and local timesharing access. BASIC was particularly popular among hobbyists. By 1978, BASIC was “the most widely known computer language,” according to Kurtz, because it appealed to a general audience, or, as Kurtz put it: “[s]imply because there are more people in the world than there are programmers” [Kurtz 1981, 535].

Kemeny and Kurtz had lifelong investments in education, and Kemeny had been involved in nationwide mathematics education efforts prior to BASIC. Kemeny was a Jewish immigrant from Hungary; he had come to the US at fourteen years old in 1940 when his father recognized the danger of increasing anti-Jewish regulations in Europe. His brilliance, especially in math, shone almost as soon as he arrived: he graduated valedictorian of his high school in New York and was drafted into the Manhattan Project while he was an undergraduate in math and philosophy at Princeton. Los Alamos was Kemeny’s first exposure to computing. Kurtz says of Kemeny: “he had been drafted and sent to Los Alamos where he worked on the precursor to the atomic bomb. They had IBM accounting machinery, ...adding and subtracting was the only thing they did. They figured out a way to solve partial differential equations using equipment, and he was involved in that” [Kurtz 2017a]. He came to Princeton and got a Ph.D. in Mathematical Logic, then joined their Philosophy Department, after which he was recruited to Dartmouth to lead the Math Department. Kemeny was connected to some of the most brilliant and influential thinkers in physics, math, and computing: at Los Alamos, Richard Feynman was his supervisor and he worked with John von Neumann; at Princeton his dissertation was supervised by Alonzo Church and he was Albert Einstein’s mathematical assistant. (Kemeny once remarked that Einstein needed an assistant because “Einstein wasn’t very good at math” [Campion 2001].) Kemeny began at Dartmouth as a full Professor of Mathematics at twenty-seven, became chair shortly afterward, then later recruited Thomas Kurtz from Princeton, along with other colleagues, to build up the Dartmouth Math Department. Kurtz described Dartmouth at the time: before the interstate highway system, Dartmouth was “way up here” and isolated, with only one graduate program — in business administration [Kurtz 2017b]. But Kemeny was loyal to Dartmouth: he served over a decade as its president (1970-1981), his two children attended Dartmouth, and he loved Dartmouth sports.

Dartmouth undergraduates in science in the early 1960s were motivated to learn how to use computers because the applications for computers were apparent to them and relatively easy to access with the use of the programming language FORTRAN. But FORTRAN was built for physics and the hard sciences. Kemeny and Kurtz wanted to reach the other 75% of Dartmouth undergraduates, those who were majoring in the humanities or social sciences. They figured that these students would be turned off from computing by the slow turnaround time of batch processing and specialized languages that relied on arcane knowledge of computer engineering. For a system to appeal to these students, it had to be accessible and intuitive and must have quick turnaround times. Kemeny and Kurtz also knew that lectures on computing wouldn’t cut it; students actually had to try their hand at programming. So, they worked toward a system that would simulate real-time responsiveness and have something closer to English language syntax: what eventually became the Dartmouth Time-Sharing System (DTSS) and the BASIC computer language [Kemeny and Kurtz 1967 (b)].

Kemeny and Kurtz wrote:

The primary goal motivating our development of DTSS was the conviction that knowledge about computers and computing must become an essential part of liberal education. Science and engineering students obviously need to know about computing in order to carry on their work. But we felt exposure to computing and its practice, its powers and limitations must also be extended to nonscience students, many of whom will later be in decision-making roles in business, industry and government. [Kemeny and Kurtz 1968, 223]

In their motivations to teach nonscience students to learn more about computers, the resonances with literacy education are apparent. Thomas Kurtz confirmed in a personal interview I conducted with him in 2017 that they did indeed think of their pedagogical project as literacy education. While they generally described their pedagogical motivations along the lines of civic engagement, as above, Kurtz also told me they were invested in the creative potential of the computer. There were others who argued earlier for computer literacy — George Forsythe in 1959 and Alan Perlis in 1961 — but Kemeny and Kurtz were the first to develop a working system to support it [Kurtz 2017b]. Given the hardware and programming languages of the time, it wasn't clear to anyone how widespread computer education could actually work. The LOGO programming language — which emphasized graphics and was designed for younger children — was developed very soon after BASIC. Kemeny and Kurtz admired Seymour Papert and the LOGO development team for their focus on abstract thinking and creativity, though Kurtz pointed out that LOGO stumbled a bit because it seemed to need an expert overseeing the learning process [Kurtz 2017b]. In contrast, BASIC was designed to be learned with very little support — just a couple of lectures or a manual. While both BASIC and LOGO circulated widely with microcomputers in the 1980s, LOGO tended to thrive in formal educational contexts and BASIC in informal, home, and hobbyist contexts, including the circulation of games like FTBALL.

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Initially, Kemeny and Kurtz were not in agreement about the need for a whole new language to teach computing but did agree that timesharing was necessary to keep the interest and attention of nonscience students. Through a regional computer-sharing agreement with MIT, Kurtz had served as the Dartmouth representative since 1956 and made trips to Boston every two weeks to use their IBM 704. He learned Assembly language for the 704 and would turn in his punch cards when he arrived at MIT in the morning then pick them up in time to catch the last train back to Dartmouth in the evening. Kurtz experienced first-hand the frustration of long turnaround times, as correcting a mistake in his programming meant he would need to wait two weeks until his next trip to MIT. John McCarthy, an early leader in artificial intelligence who knew the context at Dartmouth because he had previously been mathematics faculty there, suggested timesharing during one of Kurtz's visits to MIT [Kurtz 1981] [Kurtz 2017b]. Kemeny and Kurtz figured that undergraduates would tolerate timesharing a computer better than batch processing punch cards — especially if they were using teletypes that were responsive enough to disguise the fact that the timesharing was happening.

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Through Kurtz's regular train trips to MIT, Kemeny and Kurtz also learned that a simpler language was often better than a more efficient one. The two-week turnaround raised the stakes on errors in their code, even minor ones. Kemeny and Kurtz used SAP (Share Assembly Language) on the IBM 704 but were frustrated by the complexity and opacity of it. Kemeny devised DARSIMCO (DARTmouth SIMplified COde) in 1956, although it wasn't used much because FORTRAN came out the next year. But, according to Kurtz, "DARSIMCO reflected Dartmouth's continuing concern for simplifying the computing process and bringing computing to a wider audience" [Kurtz 1981, 516]. Moreover, after the difficulties of programming in SAP versus the much more intuitive FORTRAN, Kurtz recognized "that programming in higher level languages could save computer time as well as person time" because the programs were less subject to human error, even though they might be technically more inefficient. Kurtz initially thought a subset of ALGOL or FORTRAN would be sufficient for their pedagogical goals, but the ways those languages treated loops and variables finally convinced him that Kemeny was right: to teach a general population of undergraduates, they needed a new language [Kurtz 1981, 519].

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In addition to the need for faster turnaround times and a simplified language, Kemeny and Kurtz made another early realization: undergraduates could do serious work in computing. As an undergraduate in 1959, Robert Hargraves developed the DART language on the newly-arrived LGP-30 computer [Kurtz 1981, 516]. Undergraduate George Cooke wrote a program in DART to predict results in the 1960 election and it predicted the results correctly — unlike NBC. Stephen Garland wrote an ALGOL interpreter for the LGP-30 while he was an undergraduate at Dartmouth as well [Murray and Rockmore 2014]. When Kemeny and Kurtz applied for NSF funding to support their pedagogical project, the fact that they had only undergraduates as assistants apparently made the grant reviewers raise an eyebrow; however, Kemeny's reputation carried the day, and they received their funding anyway [Murray and Rockmore 2014]. Later, Kemeny and Kurtz both credited undergraduates as key to the development of the success of BASIC and DTSS. They noted that in April 1964, their undergraduates worked 50 hours a week on the system — although they were keen to point out that none of them failed any courses as a result [Kemeny and Kurtz 1968, 224–5]. A lot of the actual

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development of the language and timesharing system was handled by undergraduates Michael Busch and John McGeachie; Robert Hargraves and Stephen Garland also worked on the system. Anthony Knapp had sketched out an initial hardware configuration draft for timesharing after a visit he and Kurtz made to GE in 1962 [Kurtz 1981]. In our interview, Kurtz repeatedly emphasized the brilliance of the undergraduates working on BASIC. Referring to himself and Kemeny, he insisted, “we were the leaders of the band; we weren’t the performers” [Kurtz 2017b]. That undergraduates were the main audience for programs also influenced the kinds of programs that got written, including games.

Dartmouth was aided by the talent and energy of undergraduates as well as the fact that the university had very little government-supported research and thus was freed from the apparent constraint to charge faculty and students for computing services. Kemeny and Kurtz were dead-set on open access of computing resources at Dartmouth, using open stack libraries as a model. Kurtz recalled, “At the time, Dartmouth had one of the largest, if not *the* largest, open stack library among universities in the country. So, the idea of open stack, open computing, open access computing is natural and obvious” [Kurtz 2017b]. Universities had different tactics for supporting recreational use of computers at the time — Kurtz insisted they weren’t necessarily iconoclastic in this. Princeton apparently had a small block of time for “unsupported” computer use. Dartmouth, which was more focused on undergraduate education, had a more open policy, which charged all uses of the computer to the Dean of the Faculty, who had the budget for the computer, and the Dean then charged government grants for the use. Kurtz called this a “fictitious charging scheme,” which enabled the computer to be available at Dartmouth like an open stack library [Kurtz 2017b]. John McGeachie, who worked on BASIC and DTSS as an undergraduate, confirmed the availability of the system: “the undergraduates who were part of the student assistantship program basically had priority of access to the machine. For all intents and purposes, it was our machine — which we shared with John Kemeny” [Murray and Rockmore 2014].

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Dartmouth College was the site of other important early innovations in computing, including a demonstration in 1940 by George Stibitz of Bell Telephone Laboratories — the first use of a computer over a communications line and using a teletype. The “Dartmouth Summer Research Project” organized by then-faculty John McCarthy in 1956 was first to use the term *artificial intelligence* as well as the birthplace of LISP. Thomas Kurtz pointed to these historical events as priming Dartmouth for BASIC [Kurtz 1981].

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The fact that Dartmouth attracted such attention to computing was key to the development of DTSS and BASIC, but even more important was that Dartmouth is a small liberal arts university, focused on undergraduates as both researchers and students. Kemeny and Kurtz were savvy enough to align their goals with the goals of the institution: “the administration and the Board of Trustees of Dartmouth gave us their full support as they, too, realized and accepted the goal of ‘universal’ computer training for liberal arts students” [Kemeny and Kurtz 1968, 223]. Myron Tribus, then the Dean of the Thayer School of Engineering and a staunch advocate of Kemeny and Kurtz’s work, wrote of the original design principles behind Dartmouth computing:

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I remember quite vividly an afternoon conversation with John Kemeny in which we agreed that certain requirements would be met even if it meant indefinitely postponing the computer.

1. Students would have free access.
2. There would be complete privacy. No one would know what the students were doing.
3. The system should be easy to learn. The computer should contain its own instructions.
4. The system would be designed to save the time of the user even if it appeared that the computer was being “wasted.”
5. Turnaround time should be sufficiently rapid that students could use the system for homework.
6. The system should be pleasant and friendly.

Tribus memo, 1977, quoted in (Kurtz 1981), 520

Kemeny and Kurtz stayed true to this vision in the technical and semantic decisions they made for BASIC, how the student computer time would be charged, and in the social structure they set up in the computing lab.

With computer literacy as a goal — rather than any grant-sponsored research agenda — the Dartmouth computing project could embrace uses of the computer that would engage students. FTBALL was an example of one of those engaging uses of the computer. As Kemeny and Kurtz noted in their final grant report for the NSF, the use of computers for games is not frivolous at all. They maintained that there was no better way to dispel fear of the computer than to play games, and that programming games was a great way to learn computing.

BASIC FTBALL as a computer game

The high expense of early computing and the seriousness of it — applications for war and big science such as ballistics, cryptography, engineering and physics — would seemingly work against its recreational applications. But there was a playful side to computing from the start. The Mark II at Manchester had a loudspeaker that emitted sounds from certain instructions, and Alan Turing discovered that “the hooter” could produce musical notes by repeating these instructions. In an all-night programming session, Christopher Strachey composed “God Save the Queen” with these instructions and, consequently, landed himself a job at the lab. A recently restored recording session from 1951 captures this plus “Baa Baa Black Sheep” and “In the Mood,” composed perhaps collaboratively by Strachey and other members of the lab [Copeland and Long 2016]. In 1952, Strachey wrote a “Love Letters” program that spat out saccharine and silly statements such as “DARLING CHICKPEA, YOU ARE MY AVID ENCHANTMENT” signed “M.U.C.” for Manchester University Computer [Wardrip-Fruin 2009]. Allen Newell, J.C. Shaw and Herb Simon wrote a chess game at Rand Corporation in the 1950s; chess has been a testing game for AI ever since [Ensmenger 2012]. The game *Spacewar!* had been written at MIT in 1962 on an inexpensive DEC PDP-1, which had a primitive CRT graphic display. *Spacewar!* circulated among university and business computing site for years and was famously described by Stewart Brand in a 1972 issue of *Rolling Stone* [Brand 1972]. IBM attempted to ban it for its unseriousness, but then rescinded the ban because the game itself was a lab for computational experiments. “Ready or not, computers are coming to the people,” Brand wrote [Brand 1972]. As Brand and so many others recognized in the 1950s and ‘60s, games of all kinds were an ideal conduit for learning about computing.

So, there was precedent for Dartmouth FTBALL as a recreational use of computers. And while Kemeny and Kurtz were serious mathematicians, they recognized that to encourage computing, recreational applications such as games were key. In his notes for a public lecture, Kemeny noted that FTBALL was “pure fun” and that “Writing Games” was a “Great way to learn programming” [Fig. 1].

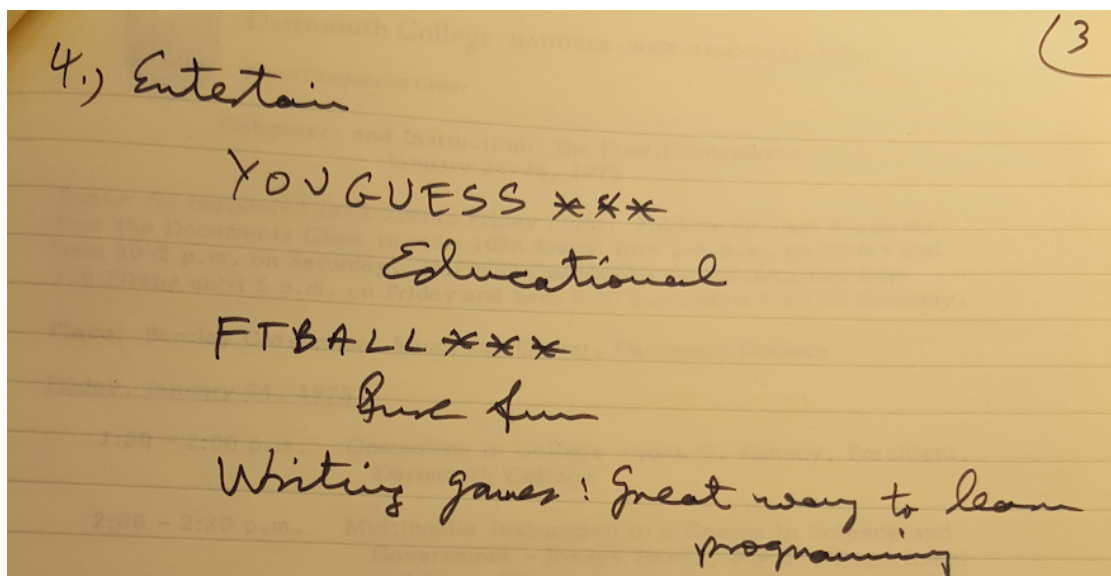


Figure 1. Kemeny's notes from a lecture on the use of computers, showing their many uses. Kemeny's notes from a lecture on the use of computers, showing their many uses. The notes read: “4. Entertain / YOU GUESS*** / Educational / FTBALL*** / Pure fun / Writing games: Great way to learn programming” Kemeny Papers, Dartmouth College, Rauner Library, accessed 2016.

FTBALL wasn't the only game at Dartmouth, either. In the 1967 final report on their grant for the NSF, Kemeny and Kurtz wrote, "Our library contains some 500 programs, including many games. We have found that a computer is an efficient and inexpensive source of entertainment" [Kemeny and Kurtz 1967 (a), 6–7]. They go on to describe the games briefly: "The student can challenge the computer to a game of three-dimensional tic-tac-toe, or quarterback Dartmouth's football team in a highly realistic match against arch-enemy Princeton. The program is somewhat biased — Dartmouth usually wins" [Kemeny and Kurtz 1967 (a), 8]. A local survey in 1967 revealed that Dartmouth students used the computer for leisure one-third of the time and enjoyed playing games [Thomas Kurtz Papers, Box 6]. The other games in the local library of programs were compelling, but FTBALL was exceptionally popular.

In Kemeny's first version, FTBALL was a one-player game, though later versions were multiplayer. A more detailed explanation of how the code worked is in a subsequent section, but here is the basic gameplay. The player — likely a Dartmouth undergraduate associated with the lab, or with connections to it — would queue up FTBALL from the lab's library and be greeted with this opening:

```
THIS IS DARTMOUTH CHAMPIONSHIP FOOTBALL
YOU WILL QUARTERBACK DARTMOUTH. CALL PLAYS AS FOLLOWS:
1 = SIMPLE RUN; 2 = TRICKY RUN; 3 = SHORT PASS;
4 = LONG PASS; 5 = PUNT; 6 = QUICK KICK; 7 = PLACE KICK.

TOSS OF COIN. (TYPE A NO. FROM 1 TO 300)
```

The game features typical football plays familiar to any fan, so no further explanation was given. Note that although the game is played against Princeton, Princeton isn't mentioned initially, and the player can only quarterback for Dartmouth. After this intro prompt, the player then enters a number for the coin toss, which results in either Princeton or Dartmouth winning the coin toss and the console's printout indicating PRINCETON WON THE TOSS or DARTMOUTH WON THE TOSS. For either team's kickoff, the ball starts on the team's own 20-yard line, which simulates the team taking a knee at the kickoff. When Dartmouth is on offense, the player can then input plays 1-7; however, when Princeton is on offense, the program chooses plays for Princeton. The program kept track of who was on offense, yardage for plays, downs, position on the field, and gave results of plays such as interceptions, successful kicks, and touchdowns. The game continued for at least 50 plays, and each play beyond that had a 20% chance of ending the game. The game ending indicated a final score:

```
END OF GAME ***
FINAL SCORE:   DARTMOUTH S(2); PRINCETON S(0)
```

The console printed the value of the variables for Dartmouth's and Princeton's score, and the FTBALL program ended.

A public conversation between Nancy Broadhead, an operator and self-described "housemother" at the lab, and John Kemeny at the National Computer Conference in 1974 provides some context for FTBALL's origin and role at Dartmouth computing:

<p>Nancy Broadhead</p>	<p>Speaking of phone calls and things, one of probably the earliest programs in the program library was FTBALL. A lot of us here know who wrote it. I remember one night we had been apparently having some problem somewhere along the line and I got a phone call at home one night to tell me in absolute panic, "FTBALL has been clobbered in the library!" I live a good half hour away from Dartmouth and I really wasn't about to jump in the car and trot in to reload it from cards, or paper tape was probably what we had for backup at that point. So I just sort of sleepily said "Well, I'll put it back in the morning." [To Kemeny:] What did you really expect me to do?</p>

John Kemeny

We were probably trying to recruit a new football coach and that seemed so terribly important. I don't remember who wrote it [Kemeny was being facetious here!] but I do remember when that program was written, it was written on a Sunday. Those were the good days when time-sharing still ran on Sundays. It was written on Sunday after a certain Dartmouth-Princeton game in 1965 when Dartmouth won the Lambert trophy. It's sort of a commemorative program.

[American Federation of Information Processing Societies 1974]

Kemeny's playful refusal to claim authorship of the program in front of an audience who would have known otherwise recalls the playfulness of the program itself.^[2] And yet his description of the possible context that drove him to call Broadhead after-hours also suggests that the program was more than fun: it served as a demonstration program for a non-expert to see what Dartmouth computing could do. In their report on the grant, Kemeny and Kurtz write, "We have lost many a distinguished visitor for several hours while he quarterbacked the Dartmouth football team in a highly realistic simulated game" [Kemeny and Kurtz 1967 (a), 6–7]. Kemeny's FTBALL game, written on a Sunday in response to a real-world game between Dartmouth and Princeton, would have appealed to the local undergraduates, but it also had real-world applications for recruiting and impressing distinguished visitors.

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Games, including FTBALL, were among the more popular exports of the Dartmouth computing library over the DTSS network that included local high schools in Hanover and neighboring Lebanon as well as regional colleges.^[3] Members of the network also wrote games, exemplifying Kemeny and Kurtz's claim in their final grant report to the NSF in 1967 that "most of the games have been programmed by our students, which is an excellent way to learn programming" [Kemeny and Kurtz 1967 (a)]. Rankin names a few of the projects of students listed in the *Kiewit Comments* from 1967, including solitaire by 12-year-old David Hornig and checkers by 13-year-old Julia Hawthorne [Rankin 2018, 77]. Game programs were popular at Exeter Academy, an exclusive, all-male (at the time) prep school 100 miles southeast from Dartmouth College that joined the Dartmouth network early on. John Warren, the collaborating teacher at Exeter who later trained other secondary school teaching partners when they joined the network, claimed in 1966 that Exeter "students and faculty have written several thousand programs," and that games were not "idle pastimes" because writing them took serious skill [Rankin 2018, 81].

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Traditional sports and card games such as football were early entries in American computer gaming in part because of their cultural familiarity — they required few directions to players. Moreover, the scoring of traditional card and sports games could be represented in numbers, which computers handled easily. Many Americans already knew the basic rules for solitaire, checkers, tennis, and football, so they could draw on existing knowledge to play these games in the limited interfaces of early computers. It's perhaps no accident that *Tennis for Two* was the first known interactive video game (written with graphics on an oscilloscope), followed by the popular *Pong* by Nolan Bushnell in 1972 [Anderson 1983]. A space game Bushnell released in 1971 sold few units, but the stripped-down interface of *Pong* and the relatable action of hitting a ball across a net led to *Pong's* huge popularity a year later [Wills 2019, 7]. Like FTBALL, *Pong* and *Tennis for Two* were iterations of a game many people already knew how to play. Preceding arcades and graphical interfaces of later football games, FTBALL was a purely textual and turn-based game, but in 1965, sports fans would have been familiar with radio broadcasts of play-by-play commentary in football and baseball.^[4] Consequently, the low-bandwidth of the game's textual version of football would not have seemed so clunky to contemporary users as it might to modern players used to graphical depictions of games.

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Later football games, arguably influenced by FTBALL, have been big players in the genre of sports games. *Atari Football* (1978) was popular in arcades, as was Atari's home version for VCS, which was released the same year. Home console football games for the Intellivision and Nintendo NES continued the trend with *NFL Football* (1979), *10 Yard Fight* (1983) and *Tecmo Bowl* (1987) [Wills 2019, 34]. Then came one of the most popular video game franchises ever: *John Madden Football*, released in 1988 by Electronic Arts and again yearly since 1990. *Madden* combines complex plays and detailed graphics with official licensing from the American National Football League (NFL), enabling former NFL coach and famous football color commentator John Madden to narrate plays that reflect real NFL strategies

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and recognizable NFL players and franchises. *Madden* is often seen as the first game that non-computer nerds took up beginning in the early 1990s. It also drew new fans into football by teaching scoring, plays, and strategies. More recent versions even include mechanics about team rosters and salary caps, so players learn about the NFL as well as the plays and strategies of football. Because so many current NFL players and coaches now grew up playing it, *Madden* has influenced the sport itself [Foran 2008], an interesting reversal from early computer games influenced by sports.

Because they translate well and rely on cultural knowledge not associated with computing knowledge, sports games have helped to bring computer games to a wider audience. Sports games also affected the evolution of computer games more generally, according to John Wills in *Gamer Nation*:

[T]hese early sports games enshrined the medium of video games as fundamentally sport-like and competitive. The opportunity to play American sports proved eminently attractive, and game consoles sold on their strength of sports titles. Video games served as an extension of fan service, part of the ritual of following favorite teams and championship events... [Wills 2019, 35]

FTBALL is thus part of this early lineage of fan service, both at Dartmouth specifically — it celebrated a Dartmouth championship game, after all — and in sports and computer games more generally.

Examining the cultural context, Rankin associates the popularity of FTBALL and its subsequent iterations with the masculine culture of Dartmouth computing. Dartmouth then and now is associated with a kind of “jock” culture and was all-male at the time Kemeny composed FTBALL. Rankin drew on interviews and archives to describe the Dartmouth computing lab scene in which FTBALL was played: Dartmouth men courting women students from nearby Mount Holyoke College, prank-calling teletypes, error messages that ribbed fellow student-workers, and frequent late night computing sessions. The participants and culture of the lab were inevitably shaped by the demographics of Dartmouth at the time. And beyond Dartmouth, dominant masculinity in computing spaces shaped the culture and kinds of programs developed in these spaces. Games of contestation — especially those that echo the masculinity of fighting, war, and sports — figure prominently in computing game history [Wills 2019]. This dominant and dominating thread of masculinity in computing and in gaming is being pried apart by contemporary historians of computing such as Rankin, Janet Abbate, Mar Hicks and Nathan Ensmenger. The scene at Dartmouth computing in the basement of College Hall was certainly shaped by the fact that all the students were men, most of them white and some from affluent backgrounds, although many of the students who worked with Kemeny and Kurtz did so through work-study support [Murray and Rockmore 2014]. It is important to note however, that Kemeny and Kurtz, as math Professors, did not have control over the student body’s composition at the time. Later, as President of the College, Kemeny pushed for and presided over Dartmouth’s 1972 transition to co-education, along with developing programs to expand Native American student enrollment [Campion 2001].

Kemeny was an avid fan of Dartmouth football, and he often attended games with his math colleagues. As one of his colleagues recalled, “They made all manner of bets based on probabilities of obscure game occurrences, such as the odds on three flags being thrown twice in a quarter” [Campion 2001]. Kemeny wrote FTBALL on Sunday, Nov 21, 1965, a celebration of Dartmouth winning the Lambert trophy in a surprise upset against Princeton on Nov 20, 1965.^[5] The game featured in FTBALL is between Dartmouth and Princeton, but Princeton isn’t in the title — it’s *Dartmouth* Championship Football. The title and the opponent, a major Ivy League rival, presumes an internal audience of Dartmouth football fans. As Kemeny and Kurtz admitted, “The program is somewhat biased — Dartmouth usually wins” [Kemeny and Kurtz 1967 (a), 8]. Quarterbacking for Dartmouth, users could choose among seven different running, passing, and kicking plays. At the time that Kemeny wrote the game, BASIC was interactive — it could take input from the user unlike earlier versions of BASIC — but it wasn’t yet capable of multiplayer games. A later iteration of FTBALL was multiplayer and announced as *FOOTBALL* in the Nov 1969 *Kiewit Comments* newsletter [Rankin 2018, 48]. Rankin noted the significance of this networked version, as it meant that students at Kiewit could play *FOOTBALL* with others in the local DTSS New England network, including secondary schools and other colleges in the area [Rankin 2018, 48–49].

Beyond the Dartmouth network, the offspring of Dartmouth Championship FTBALL had longstanding appeal outside of

Dartmouth as well. *FOOTBL* (“Professional football”) and *FOTBAL* (“High School football”) circulated in the first BASIC computer games book, written by David Ahl and published by DEC in 1973 [Good 2017]. The 1978 edition featured Dartmouth Championship Football with the byline of Raymond Miseyka, though credit was given in the accompanying text to John Kemeny for the original version. The 1978 version of FTBALL is clearly based on Kemeny’s: for instance, it features Kemeny’s original seven plays. It augments Kemeny’s original by allowing the user to input an opponent name, handling errors, and including chance events like “GAME DELAYED. DOG ON THE FIELD.” This line refers to a bizarre but regular occurrence in 1960s Dartmouth football: wild dog stoppages. According to Jean Kemeny’s memoir *It’s Different at Dartmouth*, wild dogs often ran free on campus and then occasionally on the football field during game days, where they would delay play.^[6] In the version from Ahl’s book, the remark (REM) reads: “JEAN’S SPECIAL,” suggesting this feature was added by Kemeny. The fact that Miseyka’s version works from Kemeny’s is further indication of the free circulation of BASIC games during this period. As the authors of *10 PRINT* demonstrate, the BASIC language and programs traveled widely and freely and thus shaped computational culture in the 1960s through the 1980s [Montfort et al 2014]. In the “Acknowledgements” of *BASIC Computer Games*, Ahl thanks Dartmouth College “For recognizing games as a legitimate educational tool and allowing them to be written on the Dartmouth Timesharing System” [Ahl 1978, xi].

Ahl also thanks Microcomputer Manufacturers “for putting computer games within the reach of every American in the comfort of their own home.” The first wave of mass-market home computers hit just prior to his publication; many of them shipped with a version of BASIC preinstalled, and games were indeed a popular application — both the playing and writing of them. Although the success of BASIC with home computers wasn’t necessarily anticipated by Kemeny and Kurtz, the technical decisions they made about the language as well as the way they allowed it to freely circulate were key to its popularity.

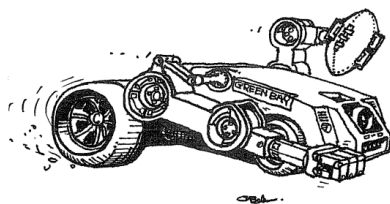
Football

Football is probably the most popular simulated sports game. I have seen some people elect to play computerized football in preference to watching a bowl game on television.

Two versions of football are presented. The first is somewhat more "traditional" in that you, the player, are playing against the computer. You have a choice of seven offensive plays. On defense the computer seems to play a zone defense, but you have no choice of plays. The computer program presents the necessary rules as you play, and it is also the referee and determines penalties when an infraction is committed. FTBALL was written by John Kemeny at Dartmouth.

In the second version of football, the computer referees a game played between two human players. Each player gets a list of twenty plays with a code value for one. This list should be kept confidential from your opponent. The codes can be changed in data statements 1770 for Team 1 and 1780 for Team 2. All twenty plays are offensive, a defensive play is specified by defending against a type of offensive play. A defense is good for other similar types of plays, for example, a defense against a flare pass is very good against a screen pass but much less good against a half-back option.

This game was originally written by Raymond Misesky of Butler, Pennsylvania.



FTBALL
CREATIVE COMPUTING MORRISTOWN, NEW JERSEY

THIS IS DARTMOUTH CHAMPIONSHIP FOOTBALL.
YOU WILL QUARTERBACK DARTMOUTH. CALL PLAYS AS FOLLOWS:
1= SIMPLE RUN; 2= TRICKY RUN; 3= SHORT PASS;
4= LONG PASS; 5= PUNT; 6= QUICK KICK; 7= PLACE KICK.

CHOOSE YOUR OPPONENT: RUTGERS

DARTMOUTH WON THE TOSS
DO YOU ELECT TO KICK OR RECEIVE? RECEIVE

34 YARD KICKOFF
42 YARD RUNBACK
BALL ON DARTMOUTH 48 YARD LINE
FIRST DOWN DARTMOUTH***

NEXT PLAY? 3
SHORT PASS. INCOMPLETE. NO GAIN
BALL ON DARTMOUTH 48 YARD LINE
DOWN 2 YARDS TO GO: 10

NEXT PLAY? 4
LONG PASS. INCOMPLETE. NO GAIN
RUTGERS OFFSIDES -- PENALTY OF 5 YARDS.

DO YOU ACCEPT THE PENALTY? YES
BALL ON RUTGERS 47 YARD LINE
DOWN 2 YARDS TO GO: 5

NEXT PLAY? 2
TRICKY RUN. 3 YARD LOSS
BALL ON DARTMOUTH 50 YARD LINE
DOWN 3 YARDS TO GO: 0

NEXT PLAY? 2
TRICKY RUN. 10 YARD GAIN
BALL ON RUTGERS 40 YARD LINE
FIRST DOWN DARTMOUTH***

NEXT PLAY? 4
LONG PASS. COMPLETE. TOUCHDOWN ***
KICK IS GOOD
SCORE: 7 TO 0

DARTMOUTH KICKS OFF
45 YARD KICKOFF
0 YARD RUNBACK
BALL ON RUTGERS 15 YARD LINE
FIRST DOWN RUTGERS***

SHORT PASS. BATTED DOWN. NO GAIN
BALL ON RUTGERS 15 YARD LINE
DOWN 2 YARDS TO GO: 10

LONG PASS. BATTED DOWN. NO GAIN
BALL ON RUTGERS 15 YARD LINE
DOWN 3 YARDS TO GO: 10

LONG PASS. INCOMPLETE. NO GAIN
BALL ON RUTGERS 15 YARD LINE
DOWN 4 YARDS TO GO: 10

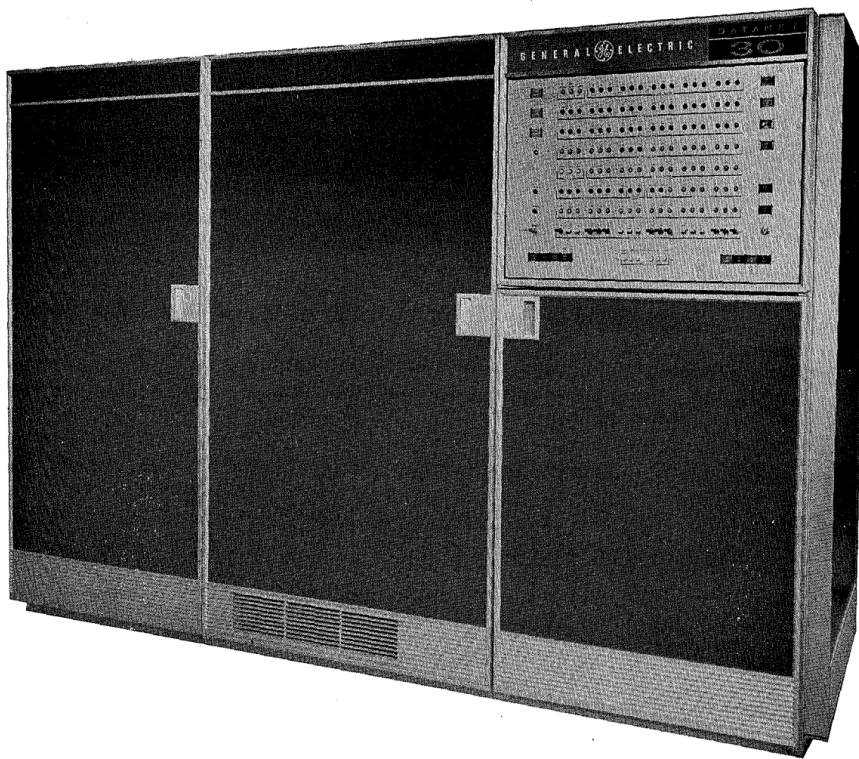
PUNT. 34 YARD PUNT
15 YARD RUN BACK
BALL ON RUTGERS 34 YARD LINE
FIRST DOWN DARTMOUTH***

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Figure 2. FTBALL as printed in 1978 Edition of BASIC Computer Games. https://annarchive.com/files/Basic_Computer_Games_Microcomputer_Edition.pdf, 64.

Hardware and technical details

Early versions of BASIC and DTSS ran on GE computer hardware, which was purchased with the NSF grants that Kemeny and Kurtz obtained, support from Dartmouth College, and discounts from GE.^[7] The first iteration of BASIC/DTSS (Phase I), which ran from 1964 to sometime in 1967, ran on two computers: a GE-235 to execute programs and a GE Datanet-30 to handle communications with the teletypes and to schedule the execution of programs on the 235 [Kemeny and Kurtz 1967 (b)]. Undergraduate Anthony Knapp had designed an early version of this setup with Kurtz [Kurtz 1981, 532]. Kemeny had borrowed a GE-225 in the Boston area to prototype the BASIC compiler in 1963, and Kurtz and undergraduate Mike Busch '66 traveled to GE in Phoenix, Arizona, to learn how to program the equipment [Dartmouth College]. The Dartmouth team called the resulting hybrid system the "GE-265" because it was a marriage between the GE-235 and Datanet 30.^[8] As Kemeny and Kurtz wrote in 1968, this two-part "system anticipated the current understanding that communication, not calculation, is the primary activity in a time-sharing system" [Kemeny and Kurtz 1967 (b), 226].^[9] The DTSS thus signaled a new computing paradigm: the most exciting challenges and affordances of computer systems in the 1960s were related to communication as opposed to the calculation paradigm of the previous decade.



DATANET - 30

Figure 3. Datanet-30, which handled communications between the GE-235 and teletypes in the BASIC/DTSS system in 1965. From the GE Datanet-30 programming manual.

Jerry Weiner was the GE project manager working with the Dartmouth team; he flew in system parts when they burned them out. He noted that: “Although the Datanet 30 was standard off the shelf, it was standard off the shelf numbered double zero and one of ten unique machines. We rebuilt it without telling other people” [American Federation of Information Processing Societies 1974, 2]. Kurtz provided more detail on their choice of the GE system when I spoke with him in 2017:

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We looked around for computers that we thought could do time-sharing. Now, there was no timesharing software available in the market, but we were looking for computers which would lend themselves to this. And we got proposals from four companies or something like that. Including IBM proposed something similar to what they were doing down at MIT, and others. BENDIX proposed something, and General Electric had a computer department in those days, and for some strange reason they had their regular computer which was called GE-225, which is an old-fashioned machine that used punch cards and so on. Then they had another computer which was designed to support a teletype communication network, they called it the DATANET-30, and it was designed to allow teletypes to communicate the same way as phones. [...] [The main machine had] floating point hardware, which we felt was essential. [...] I don't know what the application was that they were thinking of, but along the way — and I don't know if they really knew what they were doing — along the way they figured out a computer interface unit to put these two computers together. They hadn't done anything with it, but that was available as something you can buy from them. [Kurtz 2017a]

The descriptions from Weiner and Kurtz are indicative of computing hardware at the time: even the off-the-shelf systems were bespoke and uncharted.

The GE-225 had been designed, in part, by Arnold Spielberg, the father of Steven Spielberg. In an internal GE

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publication, the younger Spielberg recalled,

I remember visiting the [GE plant in Phoenix, AZ] when dad was working on the GE-225....] I walked through rooms that were so bright, I recall it hurting my eyes. Dad explained how his computer was expected to perform, but the language of computer science in those days was like Greek to me. It all seemed very exciting, but it was very much out of my reach, until the 1980s, when I realized what pioneers like my dad had created were now the things I could not live without. [GE Reports Staff 2015]

The GE-225 was designed in 1959, and with dozens of early sales, it was a marketing success. Several banks bought the GE-225, and a machine at First Union National Bank predicted the 1964 Johnson-Goldwater race. Related to FTBALL, a GE-225 was used by the Cleveland Browns for ticket sales. As *GE Reports* quotes, “‘Who knows,’ quipped the Browns’ president Art Modell in 1966, ‘there might come a time when computers will help call the next play.’” [GE Reports Staff 2015]

BASIC was designed with a teletype interface rather than punch cards for accessibility reasons [Kurtz 1981, 521]. Along with better teletypes for interfacing, the development of ASCII in 1963 “came along in the nick of time” [Kurtz 1981, 519]. Following up on his description of the “GE-265” setup, Kurtz narrated:

Then we would set this up and the whole idea was, we would put teletype machines in the various departments around on campus; we’d have a place where students could go and sit on a teletype machine and write programs. [Kurtz 2017b]

When FTBALL was written (1965), there were about 30 of the Teletype Models 33 and 35 terminals around campus and the computing lab was located in College Hall. They were planning to replace the hardware with a GE-635 and move to a new building; the Kiewit Center was dedicated in 1966 [Kurtz 1981, 528]. With this bespoke hardware setup for FTBALL sketched out, we can move into the language design of BASIC at the time.

BASIC as a beginner’s language

In the early 1960s, computation was at such a premium that most computer experts believed that languages needed to prioritize computational efficiency at the expense of usability. Mark Marino discusses John von Neumann’s supposed response to FORTRAN as a more accessible language: he believed that it was a waste of computer time to have it do the clerical work of legibility and style. This tradeoff takes on a gendered meaning given that clerical staff and computer technicians were often women, while the machine language writers and designers were men [Marino 2020, 149]. Kemeny and Kurtz did not share von Neumann’s view. Kurtz had come to the realization — after finding FORTRAN more efficient than assembly languages, which were more prone to human error — that the tradeoff between human use and computational efficiency wasn’t so simple. A language that was easier to use would be quicker for students to learn, more students could learn it, and they would be more successful in their programs. Kurtz explained in an internal memo from 1963: “In all cases where there is a choice between simplicity and efficiency, simplicity is chosen” (quoted in (Kurtz 1981), 520). Consequently, a number of technical decisions were made in BASIC to prioritize simplicity and legibility of the language over computational efficiency.

Some examples of technical choices Kemeny and Kurtz made to simplify BASIC include: hiding *object code* from the user, who could make edits directly in BASIC by using line numbers; keeping case-insensitivity even when 8-bit ASCII allowed for both upper and lower case; and reducing compiling time by skipping an intermediary language [Kurtz 2017a]. BASIC treated numbers in ways that valued an intuitive sense of users over computation time. For example, BASIC “wasted” computer time by treating all numbers as double-precision floating point numbers, the most computationally expensive and precise representation of numbers at the time, rather than having users specify number type.^[10] Moreover, the user didn’t need to know about formatting the number for printing, as other languages required.

Commands in BASIC were designed to be *friendly* (see the Tribus memo quoted above) and written in non-technical words lay English speakers would understand. BASIC used monitor commands such as SAVE, HELLO, RUN, GOODBYE

instead of LOGON and LOGOFF. Short error messages in English and limited to only five messages per run of the code worked toward simplification as well as good pedagogy [Kurtz 1981, 522]. The use of English words and commands in BASIC were thought to make the program easier to understand. Of course, this assumes users would know at least basic English vocabulary, which was the case for any Dartmouth College student. In his analysis of FLOW-MATIC, which also relied on English vocabulary to make programs ostensibly easier to read, Marino breaks down some of the challenges to English-syntax as accessible programming design (149-152). Beyond the obvious critiques of Global English as a tool for colonization, because languages like FLOW-MATIC, COBOL, or BASIC cannot handle the complexities of English syntax, they end up reading as stilted and awkward rather than the *natural language* they aspire to. Whether they are more legible than more abstract symbolic representation is a matter of debate. However, for the very newest users who might be turned off by jargon — the very users Kemeny and Kurtz were aiming for — the friendlier “HELLO” might have helped them overcome an initial fear of computing.

Given BASIC’s purpose as a learning language, Kemeny and Kurtz built good pedagogical principles of composition feedback into the system itself. To encourage students to correct their own errors, Kemeny and Kurtz designed the compiler not to check line by line prior to compiling [Kurtz 1981, 522]. As they wrote in 1968, “We find the instantaneous error messages of other systems annoying and a waste of time. It is very much like having an English teacher look over your shoulder as you are writing a rough draft of a composition. You would like a chance to clean up a draft before it is criticized” [Kemeny and Kurtz 1968, 227]. This insight aligns with best practices in writing feedback, especially in Writing Center research, that instructors giving too much attention to lower-order concerns such as individual grammar errors can detract from a writer’s own recognition of error patterns.

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Though they steered away from instantaneous error messages that would discourage self-correction, Kemeny and Kurtz realized that rapid response was key for a timesharing system. Batch-processing, where a computer tech feeds in cards and users receive results hours later, was not going to work for casual users. But Kemeny and Kurtz saw that if users received a response to their program in less than 10 seconds in a timesharing system, users had the helpful illusion that the computer was *theirs* [Kemeny and Kurtz 1968, 227]. Interpreted languages could provide this more rapid feedback; however, they were more computationally expensive. Had BASIC been an interpreted language, it would have been prohibitive to run anything more complex than the simplest programs on the hardware they had available. Consequently, early versions of BASIC, including the one FTBALL is written in, were compiled rather than interpreted. Later versions of BASIC for minicomputers such as the PDP/8 were interpreted [Kurtz 1981, 523].

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Recognizing the value of rapid feedback, Kemeny and Kurtz worked toward the one-pass ideal that interpreted languages offer by implementing a *pass and a half* system to speed up compiler time for BASIC [Kurtz 1981, 522]. The BASIC compiler could handle everything in one pass,

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with one exception — a GOTO statement could refer to a point later in the program, a point not yet reached by the compiler. The solution was to produce a linked-list of the location of GOTO statements in the student’s program. At the end of the compile main run, it ran through the linked list, filling in the blanks. We sometimes called it a “*pass and a half*.” [Kurtz 2017a]

BASIC scaled well for more complex programs by using this single-pass plus linked-lists compiling design.

Earlier language development and experimentation set the stage for the development of BASIC, giving Kemeny and Kurtz key insights on what language features were critical to a student-oriented system and simplified user interface. At Dartmouth, they developed ALGOL 30, so-named because it ran on the LGP-30, which could not run a full implementation of ALGOL 60, an influential and popular language at the time, especially among academics. From ALGOL 30, which had to be run on paper tape and was a two-pass, *batched* system, they learned that “the delays between presenting the source code tape and the execution were too great to allow for widespread student use.” Subsequently, undergraduate (and later faculty member) Stephen Garland developed SCALP (Self Contained ALgol Processor), to avoid batching. The success of SCALP (hundreds of students learned it at Dartmouth in the early 1960s) taught Kemeny and Kurtz that quick turnaround and use of only source language for programming and patching were key for a system that might have wider implementation among students [Kurtz 1981, 517]. DOPE (Dartmouth

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Oversimplified Programming Experiment, written by Kemeny in 1962) was also a precursor to BASIC and contributed, among other things: line numbers that served as jump locations; interchangeable upper and lower case letters; printing and input formats [Kurtz 1981, 518].

Line numbers were how a BASIC program in 1965 managed program flow and edits. BASIC programs were typically organized by line numbers counted by 10s, which left space in-between for additions. Every line that began with a number was assumed by the system to be part of the program, and (through the *pass and a half* system) line numbers were automatically sorted in order so that additions, deletions and edits could be appended and then sorted correctly into the program flow at compile time. Commands that didn't begin with line numbers were read as monitor commands [Kurtz 1981, 521].

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The GOTO command was used in program flow to jump to different parts of the program, often after conditional statements, e.g., GOTO LINE 20. GOTO was not an innovation of BASIC, as even FLOW-MATIC had used the command along with JUMP TO [Marino 2020, 139–144]. Later, structured languages allowed for function call by name instead of line numbers and BASIC itself became a structured language in later versions. But in 1965, GOTO was the way to direct program flow to different functions based on input. GOTO was famously derided in an article by Edsger Dijkstra in 1968, “GOTO Considered Harmful”, which launched a whole genre of computer science articles on “considered harmful” practices in the profession. Dijkstra was opposed to GOTO because the unique coordinates of the GOTO affected program flow but they were “utterly unhelpful” in tracing the progress of the program — that is, in the user figuring out just what was going on when. Moreover, the GOTO statement is “too much of an invitation to make a mess of one's program” [Dijkstra 1968]. As a result of Dijkstra's influence, deriding GOTO seems almost as popular a sport among programmers as football. However, the strong claim against GOTO, especially for understanding program flow, isn't clear. Frank Rubin wrote to *Communications of the ACM* in 1987 against the religious belief against GOTO and pointed out examples where GOTO reduced complexity in programs [Rubin 1987]. For new users who are unfamiliar with programming structures, following program flow by line number is simple. As with many choices for BASIC, Kemeny and Kurtz elected to implement what might be most self-explanatory for *new* users. With the background of these technical decisions in the language of BASIC itself, let's move on to the specific commands and code of FTBALL as representative of early BASIC in 1965.

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FTBALL's code

The code for FTBALL is written in the third edition of BASIC, the first edition to be interactive — effectively, the first edition that was conducive to games. The first edition of BASIC was outlined in a reference manual, likely written by Kemeny; the second edition was described in a primer, likely written by Kurtz. These documentation shifts from technical manual to primer indicate how the Dartmouth team was developing the language to handle a larger scale of users. The third edition added the INPUT statement to BASIC, which allows programs to take data from the user. This meant BASIC programs could change results based on user input. So, a user could play a game and expect the result of the game to be affected by their choices. The third edition manual is dated 1966 but since FTBALL was written in the fall of 1965 by Kemeny, it's likely he was implementing the newer version of BASIC code ahead of the documentation of it [Kurtz 1981, 526].

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FTBALL was called that because of a six-character limit for strings in BASIC at the time. All functions were limited to three characters: LET, INT, RND are examples of such functions described below. Kurtz later called this decision “unfortunate” for legibility [Kurtz 1981, 524]. FTBALL also demonstrates the original BASIC convention of variables consisting of one letter and one number. Kemeny and Kurtz specified variables this way for the sake of time: shorter variables were quicker during the computer's symbol table lookup. Plus, they figured it was faster to compose programs with shorter variable names and, because they were mathematicians, they were accustomed to single-letter variable names. It didn't seem consequential to have variables named in this obscure way, although like the three-character function limit, it later became clear that more descriptive variable names might make the program easier for users to read [Kurtz 1981, 523]. But, as with any language design decision, the tradeoffs were often between legibility and how much space a program would take up. Characters took up space in memory.

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As with every BASIC program of its time, each line of FTBALL contains an instruction number (line #), operation (such as LET), and operand (e.g., a variable) [Kurtz 1981, 522]. And also demonstrated here, all BASIC statements begin with an English word, including the final END. Although the ASCII standard had recently allowed for lower-case letters and BASIC accepted them, the commands for FTBALL are in all-caps likely because of convention — either lower or upper case would have been interpreted the same [Kurtz 2017a].

The BASIC commands in use in FTBALL are (in the order they appear in the program):

REM: comments or *remarks*. They didn't pull the syntax of "comments" from FORTRAN or ALGOL, and Kurtz admits "the reason is not recorded for choosing the statement REM or REMARK in BASIC" [Kurtz 1981, 525].

PRINT: This command displays characters to the teletype screen. It relies on the analogy of physical "print." There were no automatic line breaks or wrap around on the display. Consequently, note that in the beginning prompt, there are two PRINT lines in a row to force breaking the directions into two lines. There are blank PRINT lines, too, just to print a space. (This technique is also featured on the cover of Rankin's book.) The PRINT statement allowed for expressions and quoted material and used the comma as a separator. Later versions of BASIC required a colon or semicolon to separate the expression and the quoted material [Kurtz 1981, 524].

INPUT: reads from a teletype file. This command made BASIC an interactive language and wasn't present in the original BASIC [Kurtz 1981, 521]; it came in the third edition of BASIC. It stopped program flow and waited for input from the user, prompted by "?" It was usually accompanied by the PRINT statement to specify what kind of INPUT was called for. The semicolon that accompanies the PRINT statement at the beginning of FTBALL allows the teletype to stay on the same line and character position. (Alternatively, the comma keeps the teletype on the same line, but moves the character position over one column, or some multiple of 15 spaces from the left margin [Kemeny and Kurtz 1967 (b), 13].

GOTO: This is a program flow command, enabling a permanent jump from one part of the program to another. GOTO is a sign of what is now called *unstructured programming* in light of later programming languages that controlled program flow by function name. The command is used here to jump to particular plays in the program.

GOSUB: This is another program flow command, but one which causes a temporary jump in program flow. The program jumps to a subroutine and then returns back to where it came from upon the RETURN command. The GOSUB routines in FTBALL are at Line 4100, 4200 and 4300, which are part of the KEEP SCORE subroutine, so it makes sense that they are called periodically as interruptions in the program.

LET: This assignment statement allows for "LET x=x+1" rather than the more standard (then and now) x=x+1 because the LET made more sense to novices [Kurtz 1981, 524]. The similar appearance of the assignment statement and the equals statement was confusing to novice programmers (both then and now).

FOR: This term came from ALGOL, although the three loop-controlling values (initial, final, step) came from FORTRAN. Kemeny and Kurtz borrowed "the more natural testing for loop completion *before* executing the body of the loop" from ALGOL [Kurtz 1981, 521].

NEXT: This command is paired with FOR and used for stepping through a loop.

IF/THEN: This is a conditional statement common in programming languages then and now. There was no ELSE statement in BASIC at the time; the ELSE is implied so that if the flow isn't stopped by any of the IFs, then the program flows automatically to the next statement (see FTBALL Lines 190 and 191). Conditional statements are so fundamental to programming that we see them first in Ada Lovelace's writing on the Analytical Engine, the ENIAC allowed for such jumps, and they're in FORTRAN as well. But FORTRAN at the time had 3-way branching (IF-THEN-ELSE) and BASIC's was simplified to remove the ELSE.

RND: This function provides a number between 0 and 1, not inclusive, to facilitate random chance in a simulation. As Kemeny and Kurtz explain, "An important use of computers is the imitation of a process from real life. This is known as a simulation. Since such processes often depend on the outcome of chance events, a key tool is the simulation of random events" [Kemeny and Kurtz 1967 (b), 65]. RND was one of ten

original functions provided with BASIC [Kurtz 1981, 524]. It required an argument, even a dummy one, an issue which they fixed later.

INT: This function turns a decimal number argument into an integer. Originally, it truncated toward zero — it just cut off any number after the decimal. It was designed to conform to the common “floor” math function in the third edition of BASIC. INT is one of the original ten functions of BASIC.

STOP: This is the final statement of the main program flow.

END: Every BASIC program ended with this statement.

The main game loop of the FTBALL program begins at line 360, which increments the number of plays in the game (variable T) and either sends the program flow to the various possible plays (1-7, stored in variable Z) or to the end game sequence (lines 375-378).^[11] The plays, result of play, and other possibilities come after that, with GOTO and GOSUB used to direct program flow to those possibilities based on user input. The title to the program is in a REM (Remark) line and user is greeted with a series of print statements to initiate the game (the last PRINT statement simply prints a blank line, and being numbered 45 suggests that it was added later for aesthetic reasons):

```
0 REM * FTBALL *
10 PRINT "THIS IS DARTMOUTH CHAMPIONSHIP FOOTBALL."
20 PRINT "YOU WILL QUARTERBACK DARTMOUTH. CALL PLAYS AS FOLLOWS:"
30 PRINT "1 = SIMPLE RUN; 2 = TRICKY RUN; 3 = SHORT PASS;"
40 PRINT "4 = LONG PASS; 5 = PUNT; 6 = QUICK KICK; 7 = PLACE KICK."
45 PRINT
```

In this initial version, there was no option to play for another team — users had to play for Dartmouth. These numbered plays refer to actual football plays and so a user familiar with football wouldn't necessarily need a description in order to play. Even those unfamiliar with the specific plays could cycle through them just by entering the corresponding number.

Next, the program initializes three variables that will come into play in the game:

```
50 LET T = 0
60 LET S(0) = 0
70 LET S(2) = 0
```

Other variables that are relevant to the play are set elsewhere:

Y keeps track of yardage on the plays

F marks whether or not a play has failed (e.g., a fumble or interception)

X is the yardage position on the field (Princeton goal is x=100; Dartmouth goal is x=0)

Z is the play, according to the key revealed at the game's beginning (1-7)

T represents how many plays have occurred in the game. The game has at least 50 plays, and each play beyond that has a 20% chance of ending the game.

D keeps track of which down the offensive team is on

The program uses the same code for plays no matter if Princeton or Dartmouth are on offense, but it marks the distinction between the two with the variable P: if P= -1 Dartmouth is on offense and if P=1 Princeton is on offense. The user plays Dartmouth and calls the plays when they are on offense using the seven options offered at the start of the game. The block of code beginning with 2680 REM PRINCETON OFFENSE begins the logic of the computer opponent, or game AI. Princeton's choice of play on offense is governed by RND functions, which down Princeton is on, and how many yards to go. Kemeny could have had Princeton just randomly select a play 1-7, but this (somewhat dizzying block) of code provides a little strategy for the computer opponent, making the game more realistic and unpredictable — and probably more fun.

The code allots space for failures on plays such as interceptions and fumbles, which are marked with the variable `F`. Some aspects of the game are not simulated. For instance, the kickoff return results in the opposing team getting the ball on their 20-yard line, as if they had taken a knee upon receiving an average kickoff. The variable `T` counts the plays in the game up to 50, at which point the game ends or has an 80% chance of continuing. `S(0)` is Princeton's score and `S(2)` is Dartmouth's score; these are arrays that store values based on the results of plays. They are updated in the `LINE 4000–4220` block and are printed at `LINE 4200` and in the end game sequence. The `GOSUB` routine is one way the program flow gets to the score code block, and then the `RETURN` takes the program back to where it left off:

```
4200 PRINT "SCORE:  " S(2); "TO"  S(0)
4210 PRINT
4220 RETURN
```

The code for `FTBALL` is simple, but it's difficult to read for a few different reasons, some of which were due to the design of BASIC at this time. Different functions for the plays are called by `GOTOS` and line numbers rather than function names, so you can't tell where the program is going unless you go to that line and figure it out. The line numbers clutter up the visual presentation of the code, and only the line numbers for lines that are called by the program through `GOTOS` or `GOSUBS` actually provide information. The `GOTOS` and `GOSUBS` in this version of `FTBALL` do indeed result in some "spaghetti code" in that different plays and results will jump around to a half-dozen arbitrary lines before resolving. (The later version in Ahl does away with some of this jumping.) The variables are single letters, which makes them difficult to understand what they represent. And in debugging, it is much more difficult to search for `Y` than Yardage, especially using the "find" tools available in a modern-day editor. There are simple remarks (`REMS`) to demarcate different parts of the program, but they don't explain what it's doing or where it's going.

Exclusivity alongside Accessibility in BASIC FTBALL

The almost inscrutable code of `FTBALL` gestures at an inherent tension in BASIC programs of its time: while the program is written in the most famously accessible language in history, certainly the most accessible language of the mid-1960s, `FTBALL` was still only effectively accessible to a small group of people. Dartmouth was all male at the time and rather exclusive; the lab was very open but it appears that women only entered it as girlfriends or housemothers. There was some economic diversity among students who worked on the project, but little apparent ethnic or racial diversity. `FTBALL` drew on knowledge of a very popular American sport not previously associated with computing culture, but still a very masculine one, much moreso than tennis, for example. The math-influenced naming of variables and lack of comments made the code hard to read, especially for anyone coming from other academic traditions.

Yet, within these obvious constraints, Kemeny and Kurtz designed a novice-oriented programming language and licensed it so that it could catapult beyond Dartmouth's high, ivy-covered walls. BASIC was simple enough that Kemeny was able to write a functional and fun game on a Sunday to commemorate a local football triumph. The game could run on the hardware Dartmouth had available in 1965, and it appealed to Dartmouth undergraduates, the main audience for `FTBALL` and for BASIC itself. The majority of Dartmouth undergraduates at the time learned BASIC, regardless of their major. And BASIC spread far beyond its exclusive origin through time-sharing, especially within nearby public and private high schools, as well as various subsequent dialects of the language that circulated because of its generous licensing. `FTBALL` spread BASIC as well, through the many versions of the game that circulated through popular books such as Ahl's and early computing networks. Kemeny's `FTBALL` inspired spinoffs in later versions of BASIC and helped to set the stage for other computer games, including more mass-market video games such as *John Madden Football*.

`FTBALL` circulated along with BASIC in the 1960s through the 1980s, both helping to make computing more accessible and more fun. But their origins in the exclusive culture of Dartmouth reflected the exclusive nature of computing in the 1960s, a legacy that continues today. While inclusivity was clearly Kemeny and Kurtz's intent for BASIC, both BASIC and `FTBALL` were constrained by powerful sociotechnical networks over which they had little control. Computing in the 1960s had significant technical limitations and it was also coalescing around a masculine professional identity [Ensmenger 2012]. Kemeny and Kurtz both benefited from elite academic networks but used BASIC to pry open those networks — just a bit. Put another way, `FTBALL` and BASIC were radically inclusive as well as products of their time.

The sociotechnical history outlined here underscores this tension, which was inherent throughout midcentury “computing for all” initiatives.

You can play Dartmouth FTBALL*** on the DTSS emulator written by John McGeachie and available here: <http://www.dtss.org/dtss/>. First register as a new user, then log in and select “Program Entry” from the upper right menu. You’ll be taken to the DTSS emulator. For the System prompt, type in OLD, then when it prompts “OLD PROBLEM NAME,” enter: FTBALL***. When it prompts READY, type RUN FTBALL***. Have fun!

DTSS Emulator

Version 1.0

```
08:21:46.587: CIU Server operational using Direct Connection
08:21:46.596: GE-235 emulator operational on host 'localhost', port 41400.
08:21:46.596: DSU Server operational using Direct Connection
HELLO !
USER NO.--000345
SYSTEM--BASIC
NEW OR OLD--OLD
OLD PROBLEM NAME--FTBALL***
READY

RUN FTBALL***

FTBALL 08:22 THU 20 JUL 2023

THIS IS DARTMOUTH CHAMPIONSHIP FOOTBALL.
YOU WILL QUARTERBACK DARTMOUTH. CALL PLAYS AS FOLLOWS:
1 = SIMPLE RUN; 2 = TRICKY RUN; 3 = SHORT PASS;
4 = LONG PASS; 5 = PUNT; 6 = QUICK KICK;' 7 = PLACE KICK.

TOSS OF COIN. [TYPE A NO. FROM 1 TO 300]? 57
DARTMOUTH WON THE TOSS
DARTMOUTH BALL ON ITS OWN 20.
DOWN 1 AND 10 YARDS TO GO.

NEXT PLAY? 4
PASS PLAY
INCOMPLETE. NO GAIN
BALL ON DARTMOUTH 20 YARD LINE.
DOWN 2 AND 10 YARDS TO GO.

NEXT PLAY?
```

Figure 4. Screenshot of the DTSS Emulator

Appendix: FTBALL*** John Kemeny, Dartmouth College, 1965

```
0 REM * FTBALL *
10 PRINT "THIS IS DARTMOUTH CHAMPIONSHIP FOOTBALL."
20 PRINT "YOU WILL QUARTERBACK DARTMOUTH. CALL PLAYS AS FOLLOWS:"
30 PRINT "1 = SIMPLE RUN; 2 = TRICKY RUN; 3 = SHORT PASS;"
40 PRINT "4 = LONG PASS; 5 = PUNT; 6 = QUICK KICK;' 7 = PLACE KICK."
45 PRINT
50 LET T = 0
60 LET S(0) = 0
70 LET S(2) = 0
100 PRINT "TOSS OF COIN. (TYPE A NO. FROM 1 TO 300)";
120 INPUT Z1
140 FOR I = 1 TO Z1
160 LET X = RND(X)
180 NEXT I
```

```

190 IF RND(Z) > 1/2 THEN 195
191 PRINT "PRINCETON WON THE TOSS"
193 GOTO 2180
195 PRINT "DARTMOUTH WON THE TOSS"
200 PRINT "DARTMOUTH BALL ON ITS OWN 20."
220 LET P = 1
240 LET X = 20
260 LET X1 = 20
280 LET D = 1
300 GOTO 2300
320 PRINT "NEXT PLAY";
340 INPUT Z
360 LET R = RND(Z)
362 LET R = R*(.97+P*.03)
370 LET T = T+1
372 IF T < 50 THEN 380
374 IF RND(Z) > .2 THEN 380
375 PRINT
376 PRINT "END OF GAME ***"
377 PRINT "FINAL SCORE:  DARTMOUTH" S(2); "PRINCETON" S(0)
378 STOP
380 LET R1 = RND(Z)
400 LET F = 0
420 IF Z > 4 THEN 520
440 IF Z = 1 THEN 620
460 IF Z = 2 THEN 700
470 PRINT "PASS PLAY"
480 IF Z = 3 THEN 820
500 GOTO 1140
520 REM PUNT
540 LET Y = INT(100*(R-.5)^3+35)
545 IF Z = 7 THEN 5000
550 IF D = 4 THEN 560
555 LET Y = INT(Y*1.3)
560 PRINT "PUNT GOOD FOR" Y; "YARDS"
562 IF D<4 THEN 580
564 LET Y1 = INT(R1^2*20)+(1-P)*INT(R^2*30)
566 PRINT "RUN BACK FOR " Y1; "YARDS"
568 LET Y = Y-Y1
580 LET F = -1
600 GOTO 1480
620 REM SIMPLE RUN
630 PRINT "RUNNING PLAY"
640 LET Y = INT(24*(R-.5)^3+3)
660 IF R1 < .05 THEN 760
680 GOTO 1260
700 REM TRICKY RUN
710 PRINT "RUNNING PLAY"
720 LET Y = INT(20*R-5)
740 IF R1 > .1 THEN 1260
760 LET F = -1
780 PRINT "*** FUMBLE AFTER ";
800 GOTO 1260
820 REM SHORT PASS
840 LET Y = INT(60*(R1-.5)^3+8)
860 IF R < .05 THEN 960
880 IF R < .15 THEN 1080
900 IF R < .55 THEN 1020
920 PRINT "COMPLETE.  ";
940 GOTO 1260
960 PRINT "INTERCEPTED.  "
980 LET F = -1
1000 GOTO 1480
1020 PRINT "INCOMPLETE.  ";
1040 LET Y = 0

```

```

1060 GOTO 1260
1080 PRINT "PASSER TACKLED. ";
1100 LET Y = - INT(10*R1)
1120 GOTO 1260
1140 REM LONG PASS
1160 LET Y = INT(160*(R1-.5)^3+30)
1180 IF R < .1 THEN 960
1200 IF R < .25 THEN 1080
1220 IF R < .70 THEN 1020
1240 GOTO 920
1260 REM RESULT OF PLAY
1280 LET X2 = X + P*Y
1300 IF X2 >= 100 THEN 1640
1320 IF X2 <= 0 THEN 2380
1340 IF Y < 0 THEN 1420
1360 IF Y = 0 THEN 1460
1380 PRINT "GAIN OF " Y "YARDS"
1400 GOTO 1480
1420 PRINT "LOSS OF " -Y; "YARDS"
1440 GOTO 1480
1460 PRINT "NO GAIN"
1480 LET X = X + P*Y
1500 IF X <= 0 THEN 2380
1520 IF X > 50 THEN 1580
1540 PRINT "BALL ON DARTMOUTH " X; "YARD LINE."
1560 GOTO 1940
1580 IF X >= 100 THEN 1640
1600 PRINT "BALL ON PRINCETON " 100-X ; "YARD LINE."
1620 GOTO 1940
1640 IF P < 0 THEN 1780
1660 IF F < 0 THEN 1740
1680 PRINT "TOUCHDOWN***"
1700 LET P = -1
1710 GOSUB 4300
1720 GOTO 2180
1740 PRINT "TOUCHBACK FOR PRINCETON***"
1760 GOTO 2180
1780 IF F < 0 THEN 1900
1800 PRINT "SAFETY***"
1810 GOSUB 4100
1820 PRINT "DARTMOUTH GETS BALL ON ITS OWN 40."
1840 LET X = 40
1860 LET P = 1
1880 GOTO 2220
1900 PRINT "TOUCHDOWN DARTMOUTH ***"
1910 GOSUB 4300
1920 GOTO 2180
1940 LET D = D+1
1960 IF F >= 0 THEN 2120
1980 IF P > 0 THEN 2060
2000 PRINT "DARTMOUTH'S BALL"
2020 LET P = 1
2040 GOTO 2220
2060 PRINT "PRINCETON'S BALL"
2080 GOTO 2210
2120 IF P*(X-X1)>=10 THEN 2220
2140 IF D < 5 THEN 2300
2150 IF P<0 THEN 2000
2160 GOTO 2060
2180 LET X = 80
2200 PRINT "PRINCETON BALL ON ITS OWN 20."
2210 LET P = -1
2220 LET D = 1
2240 PRINT "FIRST DOWN***"
2242 IF P < 0 THEN 2250

```

```

2244 IF X < 90 THEN 2260
2246 LET X1 = 90
2248 GOTO 2320
2250 IF X > 10 THEN 2260
2252 LET X1 = 10
2254 GOTO 2320
2260 LET X1 = X
2280 GOTO 2320
2300 PRINT "DOWN " D; "AND " 10 + P*(X1-X); "YARDS TO GO."
2320 PRINT
2340 IF P > 0 THEN 320
2360 GOTO 2680
2380 IF F < 0 THEN 2580
2400 IF P > 0 THEN 2480
2420 PRINT "TOUCHDOWN***"
2440 LET P = 1
2450 GOSUB 4300
2460 GOTO 200
2480 PRINT "SAFETY***"
2490 GOSUB 4100
2500 PRINT "PRINCETON GETS BALL ON ITS OWN 40."
2520 LET X = 60
2540 LET P = -1
2560 GOTO 2220
2580 IF P > 0 THEN 2640
2600 PRINT "TOUCHBACK FOR DARTMOUTH."
2620 GOTO 200
2640 PRINT "TOUCHDOWN PRINCETON ***"
2650 GOSUB 4300
2660 GOTO 200
2680 REM PRINCETON OFFENSE
2700 LET P = -1
2720 IF D > 1 THEN 2840
2740 IF RND(Z) > 1/3 THEN 2800
2760 LET Z = 3
2780 GOTO 3120
2800 LET Z = 1
2820 GOTO 3120
2840 IF D < 4 THEN 2920
2860 IF X <= 30 THEN 2910
2880 LET Z = 5
2900 GOTO 3120
2910 IF 10 + X - X1 < 3 THEN 2740
2912 LET Z = 7
2914 GOTO 3120
2920 IF 10+X-X1 < 5 THEN 2740
2940 IF X > X1 THEN 3060
2960 IF RND(Z) > 1/2 THEN 3020
2980 LET Z = 2
3000 GOTO 3120
3020 LET Z = 4
3040 GOTO 3120
3060 IF RND(Z) > 1/4 THEN 3100
3080 GOTO 2980
3100 GOTO 3020
3120 GOTO 360
4000 REM KEEP SCORE
4100 LET S(1-P) = S(1-P)+2
4200 PRINT "SCORE: " S(2); "TO " S(0)
4210 PRINT
4220 RETURN
4300 IF RND(Z) > .8 THEN 4350
4310 PRINT "KICK IS GOOD"
4320 LET S(1-P) = S(1-P)+7
4330 GOTO 4200

```



```

4350 PRINT "KICK IS OFF TO THE SIDE"
4360 LET S(1-P) = S(1-P)+6
4370 GOTO 4200
5000 REM FIELD GOAL
5001 PRINT "PLACE KICK"
5005 LET F = -1
5006 IF R > .5 THEN 5010
5007 PRINT "KICK IS BLOCKED***"
5008 LET Y = -5
5009 GOTO 1480
5010 IF P < 0 THEN 5200
5020 IF X+Y >= 110 THEN 5100
5030 IF X + Y < 80 THEN 5060
5040 PRINT "KICK IS OFF TO THE SIDE."
5050 GOTO 1740
5060 PRINT "KICK IS SHORT."
5070 GOTO 1480
5100 PRINT "FIELD GOAL ***"
5110 LET S(2) = S(2)+3
5120 GOSUB 4200
5130 GOTO 2180
5200 IF X-Y <= -10 THEN 5300
5210 IF X-Y > 20 THEN 5060
5220 PRINT "KICK IS OFF TO THE SIDE."
5230 GOTO 2600
5300 PRINT "FIELD GOAL ***"
5310 LET S(0) = S(0)+3
5320 GOSUB 4200
5330 GOTO 200
9999 END

```

Acknowledgements

I'm indebted to Thomas Kurtz — not only for his work on BASIC, but also for his time in 2017 when I interviewed him at Dartmouth and we corresponded about BASIC's design. I'd also like to thank Steven Garland and John McGeachie (who were part of the Dartmouth undergraduate team working on BASIC and DTSS in the mid-1960s) for some details and clarifications about BASIC.

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Notes

[1] This interview was not part of a larger study, but instead was my attempt to understand more about the potential connections between Dartmouth BASIC and Kemeny and Kurtz's understanding of what Kemeny later called "computer literacy", as well as any potential connections between Dartmouth BASIC and an English teaching seminar held on campus in 1966, commonly called the Dartmouth Seminar in my field of Rhetoric and Composition. As I note in my reflection on an exhibit I produced for that 1966 Seminar, there was no connection between the Dartmouth Seminar and the development of BASIC at Dartmouth in the 1960s [Vee 2021]. Yet the interview was still quite useful to me in understanding the ideas and history behind BASIC's development, and I'm grateful to Thomas Kurtz for granting me his time.

[2] Joy Lisi Rankin reads this exchange less playfully, as an indication of the gendered hierarchy at Dartmouth computing, where the "housemother" (Broadhead) is called to work afterhours by the lab director (Kemeny) [Rankin 2018, 47]. Given the tone of the entire discussion, this particular exchange, and other descriptions of Kemeny's working relationships, I see this exchange as playful as well as reflective of expected gendered working relationships in the 1960s and '70s. He did presume to call her about work in the middle of the night, but she felt empowered to tell him it could wait until morning — and then tease him about it publicly years later, where he admits the frivolity of his request.

[3] See Rankin, Chapter 3 "Back to BASICs" for a detailed discussion and maps of the growing Kiewit network, so named by the computing center in 1967.

[4] I'd like to thank an anonymous reviewer for pointing out the context of radio sports commentary for the time period.

[5] Kemeny noted in the 1974 Pioneer Day session that he wrote it on a Sunday in 1965, the day after the game. I found the football schedule listed on Wikipedia to figure out which day that was, exactly: https://en.wikipedia.org/wiki/1965_Dartmouth_Indians_football_team

[6] From this blog post, archived from *Techmo Bowlers*: <https://bowlers102.rssing.com/chan-58312418/article38.html>

[7] Kemeny and Kurtz did not make the obvious choice of IBM because they perceived IBM representatives as bullies during the selling process, plus GE was more interested in the educational applications and willing to provide them with these discounts [Kurtz 2017b].

[8] For a good explanation of the technical aspects of the timesharing system, see Rankin 2018, pp. 24–25.

[9] They used the term *master-slave* for the system design, which was standard at the time and is only now being renamed as a *controller-peripheral* arrangement (see Landau).

[10] From Kurtz memo to Annette Vee 9.29.17: “Grammatical Simplifications in BASIC”

All other programming languages introduced number types to correspond to the hardware. For example, languages like Pascal might have single-precision and double-precision number types of both integer and floating-point. Programmers could then use, for a particular quantity, the type that provided the greatest efficiency. (Integer arithmetic in almost all computers was much faster than floating-point arithmetic. In fact, in the early GE computers, floating point calculations required a separate large hardware component. In some other computers, there being no floating-point hardware, the system had to rely on software subroutines to perform that kind of calculation.)

In BASIC, we decided that all arithmetic would be done in the computer using double-precision floating-point, which was, of course, much slower than an integer calculation. As an example, the simple looping statement `FOR I = 1 TO 10` would, nonetheless, represent the value of I (internally) as a double-precision floating-point number.

However, we reasoned that almost all students would be writing short programs whose execution times would be trivial, at least in comparison to the compiling time. This assumption turned out to be true, especially since the BASIC compiler was, because of the simple language, quite fast.

[11] These line numbers suggest that Kemeny added them later in his composing process, as the convention for BASIC programming was to increment lines by 10s (10, 20, 30, ...), leaving the in-between numbers for later additions.

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