Cannabis Data Science

Cannabis Data Science #59

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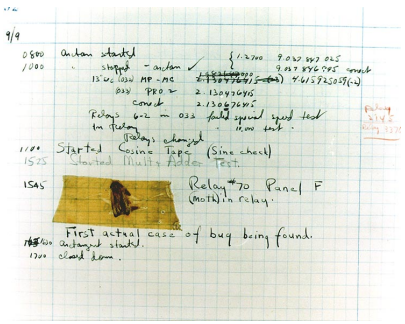
Looking back at the history of computing...

The Importance of Computers

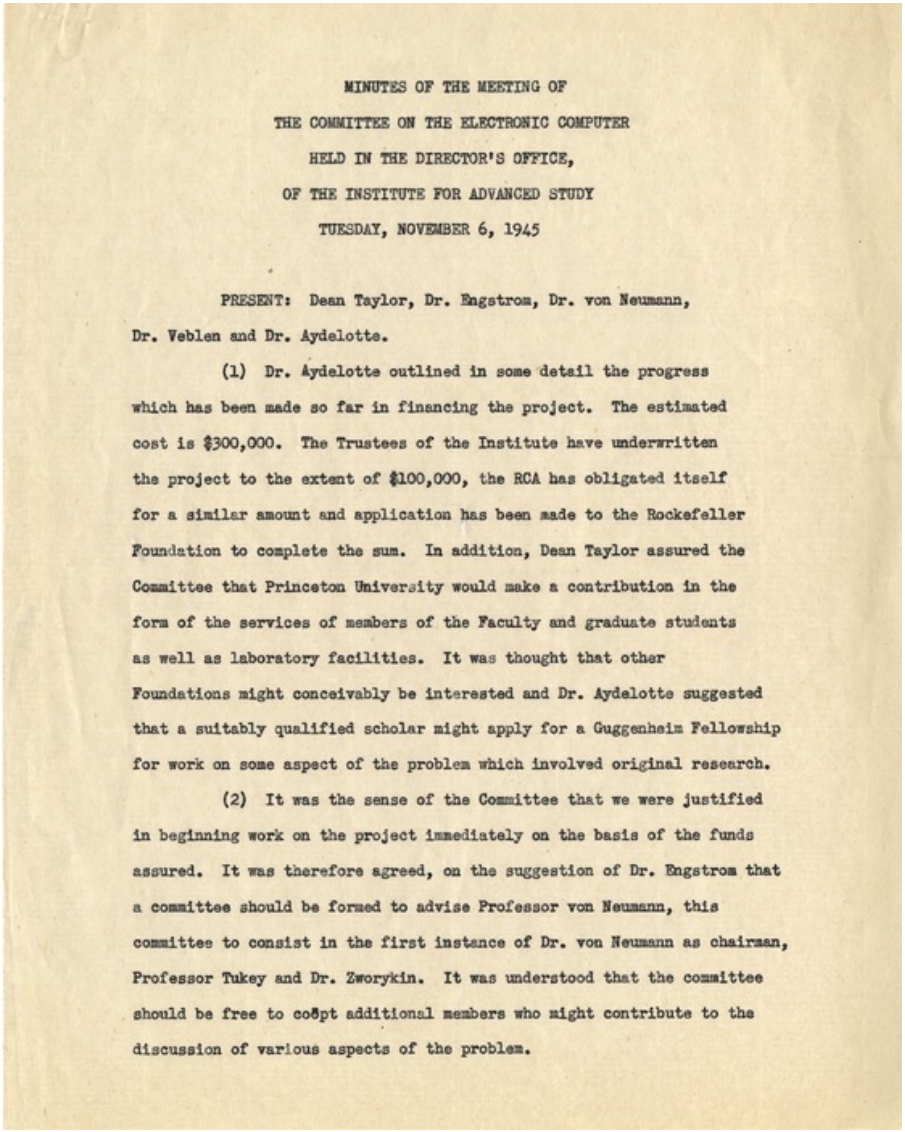
- Mathematician **Grace Hopper** ("Grandma COBOL") completes A-0, a program that allows a computer user to use English-like words instead of numbers to give the computer instructions in 1952.
- Helped the first commercial electronic computer and applications for COBOL (common-business-oriented language).
- 70 years later, Google's fourth undersea internet cable, named Grace Hopper, connecting the US, UK, Spain, and is expected to soon be operational (2022).

Grace Hopper, Washington DC, 1978.



First actual case of a bug being found (1960).

From Top Secret to Open Access



MINUTES OF THE MEETING OF
THE COMMITTEE ON THE ELECTRONIC COMPUTER
HELD IN THE DIRECTOR'S OFFICE,
OF THE INSTITUTE FOR ADVANCED STUDY
TUESDAY, NOVEMBER 6, 1945

PRESENT: Dean Taylor, Dr. Engstrom, Dr. von Neumann, Dr. Veblen and Dr. Aydelotte.

(1) Dr. Aydelotte outlined in some detail the progress which has been made so far in financing the project. The estimated cost is $300,000. The Trustees of the Institute have underwritten the project to the extent of $100,000, the RCA has obligated itself for a similar amount and application has been made to the Rockefeller Foundation to complete the sum. In addition, Dean Taylor assured the Committee that Princeton University would make a contribution in the form of the services of members of the Faculty and graduate students as well as laboratory facilities. It was thought that other Foundations might conceivably be interested and Dr. Aydelotte suggested that a suitably qualified scholar might apply for a Guggenheim Fellowship for work on some aspect of the problem which involved original research.

(2) It was the sense of the Committee that we were justified in beginning work on the project immediately on the basis of the funds assured. It was therefore agreed, on the suggestion of Dr. Engstrom that a committee should be formed to advise Professor von Neumann, this committee to consist in the first instance of Dr. von Neumann as chairman, Professor Tukey and Dr. Zworykin. It was understood that the committee should be free to coöpt additional members who might contribute to the discussion of various aspects of the problem.

The Electronic Computer Project (1945-1947)

- Led by Professor John von Neumann.
- Put into the public domain.
- 20,000,000 multiplications took 6 hours of continuous computing.

"There are two kinds of people in the world:
Johnny von Neumann ..."

"...and the rest of us."

- Eugene Wigner

Searching for the origins of data science

John von Neumann founded the field of **game theory**.

- *Theory of Games and Economic Behavior*, von Neumann and Morgenstern (1944).
- von Neumann—Morgenstern utility function:

$$U(p) = \sum_{k=1}^{K} u(x_k) p_k$$

  where p_k is the probability of outcome k that, if realized, provides payoff x_k, and function u expresses the utility of each respective payoff.
- Today, **Bayes' Theorem** is used to endogenized probability, making it subjective. Subjective probabilities are updated in light of new information, thus connecting the concepts of **rational choice** and inference.

Jumping into Game Theory

Repeated Games

- **Finite games**: Usually solved by backwards induction.
- **Infinite games**: Typically, difficult to solve.
- Even if the game being played in each round is identical, repeating that game a finite or an infinite number of times can, in general, lead to very different outcomes (equilibria), as well as very different optimal strategies.

Modeling Player Preferences

Given that player i's valuation of the game diminishes with time depending on a **discount factor** $\delta < 1$, then player i's utility is

$$U_i = \sum_{t \geq 0} \delta^t u_i(x_t)$$

where

$$u_i(x_t) = \sum_{k=1}^{K} u_i(x_k) p_k$$

The cutting edge is repeated games with incomplete information, where players have to formulate beliefs about probabilities, p.

Solving Games

Nash Equilibrium – A strategy profile for a game in which no player has a profitable unilateral deviation.

Subgame Perfect Nash Equilibrium – A strategy profile for a dynamic game with Nash equilibrium for every subgame.

Bayesian Nash Equilibrium – A strategy profile that maximizes the expected payoff for each player given their beliefs and given the strategies played by the other players.

Congestion Model

Given

- Cannabis producers, $i = 1, ..., N$,
- Cannabis products, $m = 1, ..., M$,
- A time horizon, $t = 1, ..., T$.

Under the following assumptions:

- Any producer can produce any product.
- The *cost* to produce an item of any type is $c = 0$.
- A producer can change the type of product it produces at a set *interval*, t_i.[1]

Strategy: Every time, t_i, a producer can choose it's product type:

1. The producer looks at the number of producers of each type, n_m,
2. The producer calculates the average profits for the producer of each product type, $E[\pi]_m$, for t_i,
3. The producer chooses the most profitable product to produce, $m*$, for t_i, taking into consideration that each other producer, $j = 1, ..., J$, will produce the product that is most profitable for them at each t_j.

Question and Hypothesis

Question of the day.

- What is the **Nash Equilibrium** of the congestion game?

Thank you for coming.

Insight of the Day

- It's all fun and **games**, until someone makes a profit!

What would you like to talk about next week?