# Day 2

Thursday, February 4, 2021     2:08 PM

- Definition of AI?
    - Circular: AI is the design and study of computer programs that behave intellegently.
        - Doesn't tell you much
    - Marvin Minsky (founding father of AI): "The engineering of intelligent artifacts"
        - Leaves out science
        - What about moral questions?
            - Called "ELSI": Ethical, Moral, Social, Implications
        - What about trying to understand human intelligence?
        - Still doesn't define intelligence
    - Roger Schank (founding nephew/2nd gen of AI): "Artificial Intelligence is what me and my friends work on, and that's not anything written in FORTRAN, or anything that Noam Chomsky does..."
        - Stupid definition
        - Based on fashion/cliques, not actual science.
    - Prof. Pollock: Intelligence is the asymptotic limit to mechanisms which perceive their environments, compress history into memory, and take actions to change their environment.
        - Different systems have different quantities of intelligence: A thermostat (an if-else statement) has a small amount of intelligence.
        - Since it's asymptotic, humans are further along than AI but not all the way there.
- Anti-AI philosophers have always thought that AI is impossible (ex: Dreyfus, Searle, Penrose), because:
    - *Didn't get the list, but all the normal arguments.*
- AI is a Pre-Science: "AI is a science in a very early phase, like alchemy, where no agreed upon methods of experimentation and validation exist, and credits assigned by political influence rather than by normative means."
    - Pollack likes this definition, but it's not totally true
        - Ex: ML has some agreed-upon techniques
- What is Intelligence?
    - Separates humans from animals? But dogs are pretty smart
    - Needed for survival? Bacteria and ants are smart
    - Specific abilities that people have and computers don't/can't?
        - A computer can do anything if specified thoroughly enough, and/or simulated very well
- Where do you draw the line between simulating lots of things and general artificial intelligence?
    - Count Basie test: You'll know it when you see it.
    - Unclear if you can just glue a bunch of smaller parts together or you need to invent something new.
- AI has been attacked from 3 points of view: Problems, Methods, and ???
    - Problems: speech, object recognition, problem solving, etc.
    - Methods: different algorithms, data structures, etc: search, inference, gradient descent, etc.
    - Motivation:
        - Scientific: understand natural and artificial intelligences and understand how they relate
        - Engineering: build things which are reliable and which work within human social structures
        - Military: build a robot army so humans don't have to fight

- ▪ Commerce: make money by improving which products you build.
- A note on simulation: You can perfectly simulate a chess game for a chess-playing AI. But, no amount of simulating hardware can ever be perfectly simulated.
- What is an AI technique?
  - ○ A specific combination of three components: knowledge, search, and representation
  - ○ This produces a program which is more flexible, more extensible, and more clear
  - ○ It also may be slower than a normal program with explicit logic
- Roots of AI come from:
  - ○ Turing/Church equivalence
    - ▪ *Get more detail from this slide*
    - ▪ If all computers are the same, then why is a brain any difference?
  - ○ Logic of Thought (Aristotle, Decartes, Boole)
  - ○ Neural Nets, Automata Theory (McCullogh, Von Neumann)
- Key belief of AI believers: PSSH: *Physical Symbol System Hypothesis*
  - ○ *With the right programming, computers will be able to think.*
  - ○ Physical Symbol System: "A machine which contains a collection of symbol structures and modification processes which can change those structures dynamically over time."
    - ▪ Basically: a computer has memory and can change that memory over time.
- Law of Representation:
  - ○ Objects of interest are mapped into symbolic form (ie. bits) and held as state.
  - ○ Operations are done on the symbolic representations
  - ○ When you reverse-map the results, they still work.
- Birth of AI: 1956 Dartmouth Conference
  - ○ Newel & Simon of Rand Corp (Newel later founded the CMU AI department, Simon won a Nobel for something else)
  - ○ Minsky: Founded MIT AI Lab
  - ○ McCarthy of Stanford: Invented Lisp
  - ○ Solomonoff: Founder of Learning Theory
- In the 1950s, the field of AI began. Nobody really knew what to work on, so did all sorts of things
- In the 1960s: computers started to be in more places, lots of interest in AI
  - ○ ELSI wasn't a big concern at the time. There were a couple books later on that raised concerns over AI ethics.
  - ○ Moonshot mentality:
    - ▪ Lots of focus on "weak" methods that didn't include any domain knowledge
    - ▪ Very optimistic timelines.
  - ○ Lots was learned
- In the 1970s, they understood:
  - ○ AI was going to take time
  - ○ Domain knowledge is very important ("strong" methods > "weak" methods)
  - ○ Importance of heuristic search
  - ○ Neural networks at the time were proved to not be powerful enough, so people gave up
  - ○ DARPA started funding five year plans for various AI things, with lots of competition for funidng.
  - ○ Started to focus on knowledge representation
- In the 1980s:
  - ○ AI became commercialized
  - ○ AI bubble burst in 1986, causing an AI Winter.
  - ○ Two industries:
    - ▪ Expert System Shell Companies
      - □ An expert system would be built with lots of knowledge from experts and an "inference engine." This allowed less-experienced people to deliver the knowledge of an expert.
    - ▪ Lisp Machine Companies

- □ Special purpose computers for research
- In the 1990s:
  - ○ No more explicit AI industry
  - ○ AI embedded into normal software (ex. HRBlock/TurboTax)
  - ○ World-class Backgammon and Chess players
  - ○ 2nd wave of neural networks (starting in 1985)
  - ○ Heyday of symbolic web (NLP on websites)
  - ○ In 1997, IBM's Deep Blue defeated the chess world champion
- In the 2000s:
  - ○ Focus on real-world problems
  - ○ Massive databases of text
  - ○ ML became big again, including being used to optimize business processes.
  - ○ 2006: 50th anniversary of Dartmouth
    - ▪ Lots of celebration, despite not having solved anything
- In the 2010s:
  - ○ Neural nets are *way* bigger
    - ▪ Smarter management of training sets and gradients
    - ▪ Heavy use of GPUs
  - ○ Robots win at Jeopardy and Go
  - ○ Applications based on huge datasets are made available:
    - ▪ Google Translate
    - ▪ Shazam
    - ▪ Speech-to-Text
    - ▪ Etc.
  - ○ Every time anyone does anything, it's hailed as The Dawn of AI™
    - ▪ Most famous example: Siri
  - ○ The Era of "Deep" Learning
    - ▪ Large and complex neural nets
    - ▪ Very large training sets
    - ▪ Tons of money in CPU/GPU time
    - ▪ Shockingly effective at some tasks
    - ▪ Even as a weak method
      - □ Because so much processing power and such big datasets.