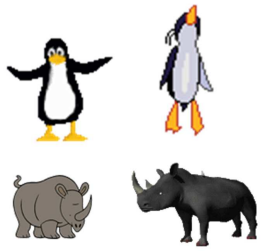
THE CS 5 SUN

Crushing Athletic Defeat



Pomona (PPI): The CS "NP-Complete Penguins" suffered a devastating blow here Saturday when they lost to the Physics "Lightspeed Rhinos" in the national gymnastics finals.

The Penguins were leading the competition until the final round, having built on the outstanding flips performed by their star, Petunia "Pirouette" Penguin, and the leaps of the renowned Peter "Popup" Prancer. The Rhinos, by contrast, had had difficulty from the beginning. They upset the judges' table when they first entered, and sullied the gymnasium floor during their admittedly thrilling synchronized charging performance.

But disaster struck when one of the Rhinos "accidentally" gored Petunia and another stepped on Peter. squashing him flat. "I'm terribly sorry," apologized the perpetrator. "I just didn't see him through my beady little eyes."

Deprived of their "A" team, the Penguins were forced to replace them with an uncoordinated CS professor, who fell flat on his face and ensured the Penguin loss.

Summer Research!

Yes, there are some research positions for frosh

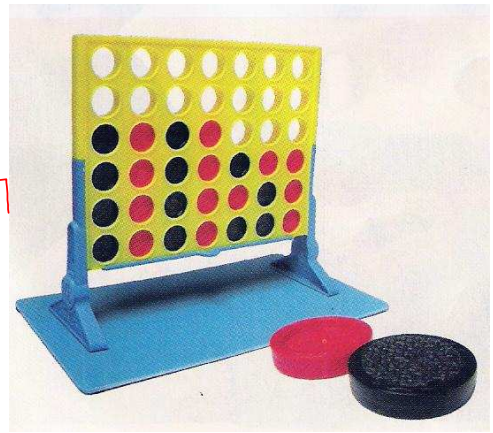
Lots of cool projects

To learn more:

- CS colloquium, Thursday Jan. 28
- 4:15 PM, Zoom to be announced
- Or join the cs-info-l mailing list

Connect Four!

Thu
11-12
7:30 AM



Rules for Connect Four

Tic-Tac-Toe with stacking

7x6 board

Checkers slide down onto top of column

Four in a row (including diagonal) wins

A `Board` Class

```
class Board:
  def __init__(self, width = 7, height = 6):
      self.width = width
      self.height = height
      self.board = [self.width*[0]
          for i in range(self.height)]
      ...
```

Artificial Intelligence

- Catch-all term for anything that "appears human"
  - Eliza
  - Chess programs
  - Expert systems
- Many approaches
  - N-ply lookahead: good for games

Looking into the Future, Part I

- Basic idea
  - Guess a move
  - See whether it makes your position better
  - Repeat for many guesses, pick best result
- What defines "better"?
  - Simple answer: use board-evaluation function

Evaluating a Connect-4 Board

- What are some ways to numerically rate a Connect-4 board?
- If opponent has won, 0
- If I have won, 100
- Otherwise…

?

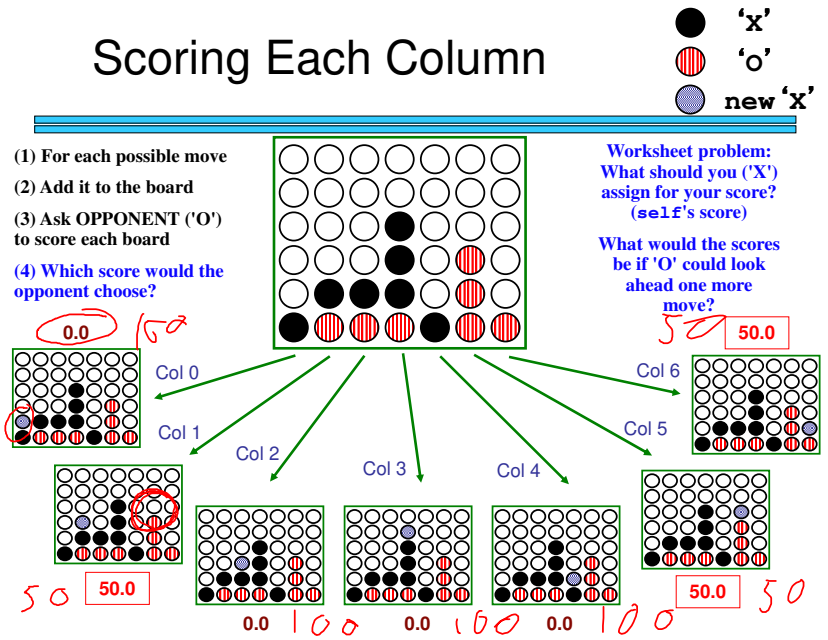
Looking Into the Future, Part II

Problem: evaluating a board is HARD

Solution: look at where the board leads

- For each possible move:
  - Make the move in “trial mode”
  - For each possible opponent's response:
    - Make that move in “trial mode”
    - Evaluate that board instead
  - Choose opponent's best option
    - This is the “worst case” for us
  - Our best move is “best of the worst cases”

Scoring Each Column



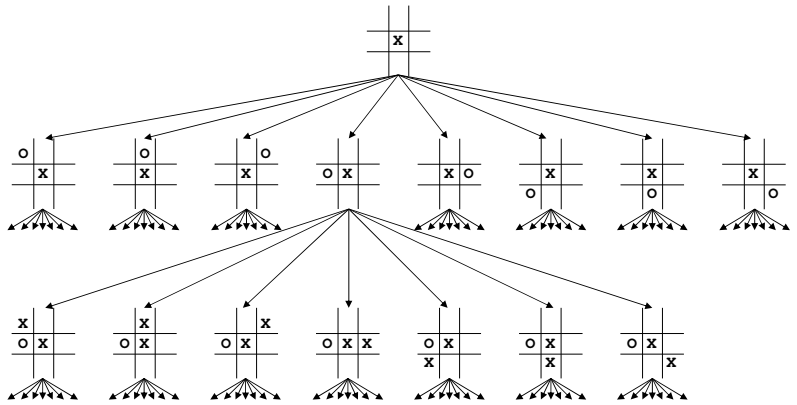
Limiting Recursion

When do we stop?

That's easy:

- When we find path that leads to a win
  - No matter what opponent does (e.g., Nim)
- When all paths lead to losses (sigh)
- When we have explored all possible moves

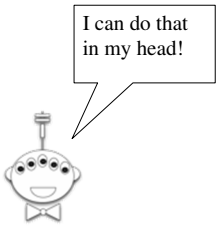
The Move Tree



How many boards in the tic-tac-toe move tree?

Explosive Growth

- Connect-4 move tree has < 7^{42} nodes
  - Roughly 311×10^{33}
- Tree size depends on two parameters:
  - Branching factor per move, B
  - Maximum moves in game, N
- Approximately B^N possibilities
  - Chess: B≈35, N≈150
  - Backgammon: B≈300, N≈50



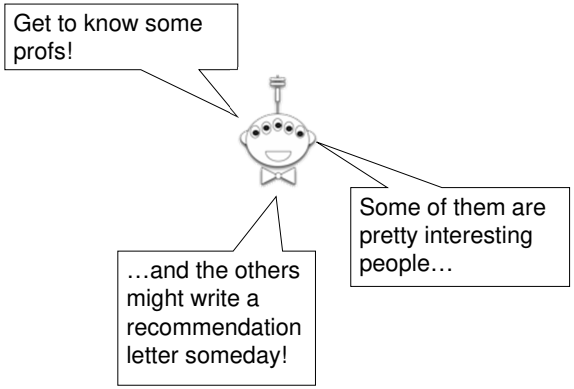
Limiting Growth

- Simplest strategy: stop looking ahead after evaluating N moves ("plies")
- Alternative: stop after *t* seconds elapsed
  - Good for chess clocks!
- Trickier: prune move tree
  - Don't follow a path if first move is *way* worse
  - Don't explore if already found better choice
  - Alpha/Beta pruning

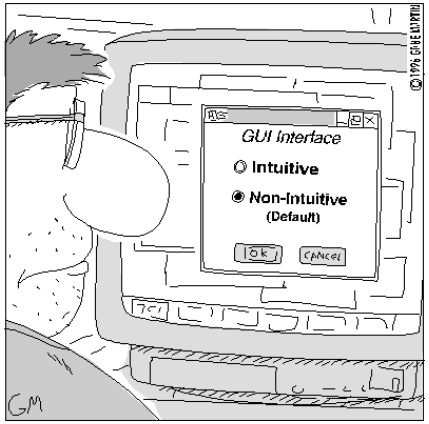
The Curse of the AI Researcher

- AI is always defined as "something a lot smarter than what my computer can do"
- Corollary: if my computer can do it, it's not artificial intelligence

The Alien's Life Advice

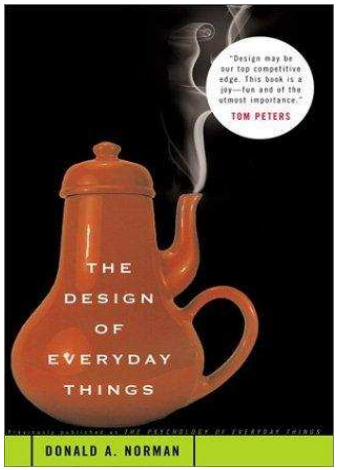


Interfaces: Programmers vs. **Users**



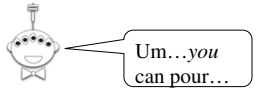
AI suddenly realizes that he's stumbled across the Mother of All undocumented Windows options.

Design For Software and Beyond



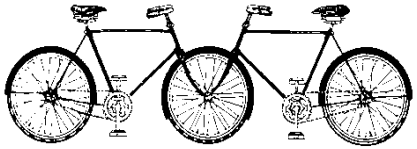
Don Norman's key principles:

1. Conceptual models
2. Mapping
3. Visibility
4. Feedback
5. Affordances

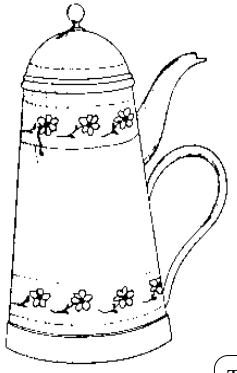


Conceptual Models

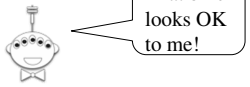
Users always bring *something* "to the table"



Images from *The Design of Everyday Things*

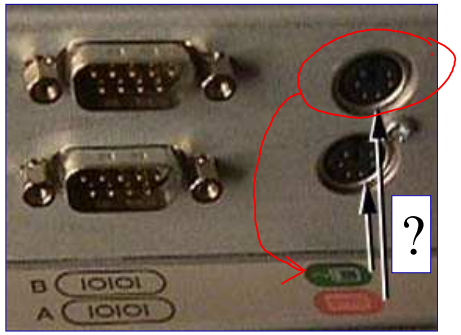


These don't work!



Mapping

Is matching expected (spatial) relationships



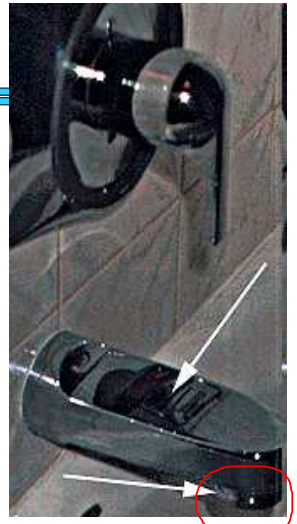
Where to plug in the keyboard and mouse?

Visibility

Is making functionality *apparent*

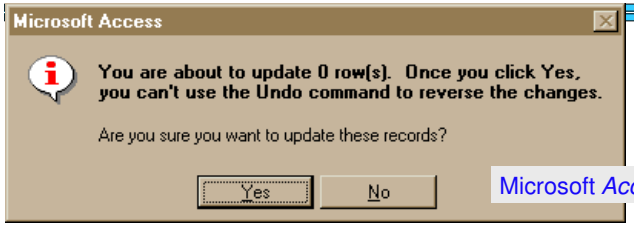
"I used to have that awful shower controller where you pull down on the nozzle to turn it on. I had to tell every guest how to do it, and when we sold our house, we got a call from the new owners about 5 days later asking how to turn on the shower. They had been taking baths for 5 days! Unbelievable." - BL

From: www.baddesigns.com

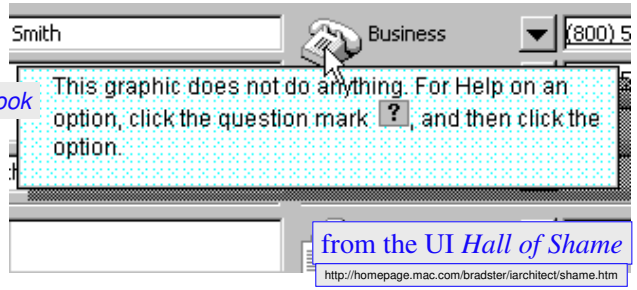


Shower?

Feedback Providing information *back to the user*



Microsoft *Access*



Microsoft *Outlook*

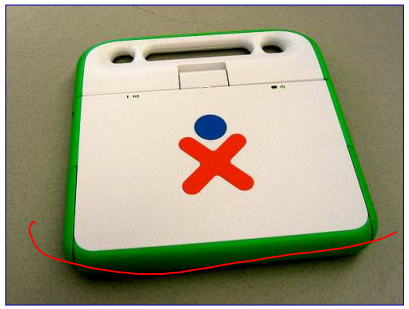
from the UI *Hall of Shame*

http://homepage.mac.com/bradster/iarchitect/shame.htm

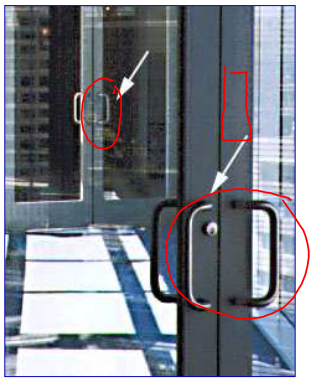
Affordances

Are the functions that form suggests…

built-in user's manual



Opening the XO?



Door handles

Norman's Principles

Mapping Meeting expectations for *spatial* relationships

Visibility Making functionality *apparent*

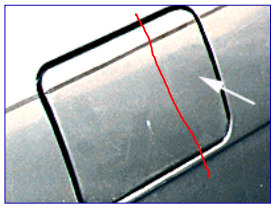
Feedback Information provided by the UI to the user

Affordances Functions suggested by an object's form

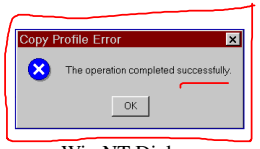
Where Do These Go Wrong?

Mapping Visibility Feedback Affordances

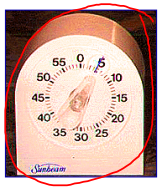
This handle … ?



How to open this gas cap?



Win NT Dialog



Set to 5 minutes?

How to turn on this stove?

User Testing in One Slide

1. Start with *paper prototypes*
2. Have sample users *think out loud*
3. Take notes or (**WAY** better) video them
4. Above all, ***don't offer help!***
5. Analyze results, go back, fix your silly mistakes, try again