**NOTICE!**

- Homework 3 theory is due tomorrow
- Lab3 Q&A
  - OOP
  - Trie demo?
- Mid term is on Monday!
  - Who needs a review session?
OBJECT ORIENTED PROGRAMMING

- four main features:
  - dynamic dispatch,
  - Abstraction
  - Subtype polymorphism
  - Inheritance

- 211 focuses on abstraction
  - For protection of code
  - Modularity
GAMES AND SEARCH
SEARCH ALGORITHM

- Aka move generations
- BFS
  - Visit all next possible moves
- DFS
  - Visit a path till it ends
- Iterative deepening
  - DFS until a certain depth
- A Star
  - Search with an overestimation heuristic
**Evaluation Algorithm**

- Minimax
  - Alpha beta pruning
- Negamax
  - Visit all next possible moves
MINIMAX

- Maximize gains, minimize lose
- For 2 players Zero-sum game.
  - I win = You lose
  - My gain = your lost
- Code Example
Minimax of a hypothetical search space. Leaf nodes show heuristic values.

http://www.cs.trincoll.edu/~ram/cpsc352/notes/minimax.html
**Alpha-Beta**

- Think of it of Minimax on hindsight
- If some node value can never be the selected, we can ignore all its children as the will not affect the outcome
- Alpha -> Max
- Beta -> Min
**Alpha-Beta**

![Game Tree Diagram](image)
1. Start at C. Descend to full-ply depth and assign the heuristic to a state and all siblings (MIN 2, 3). Back up these values to their parent node (MAX 3).

2. Offer this value to the grandparent (A), as its beta value. So, A has beta = 3. A will be no larger than 3.

3. Descend to A’s other grandchildren. Terminate the search of their parent if any grandchildren is >= A’s beta. Node B is beta-pruned, as shown, because its value must be at least 5.

4. Once A’s value is known, offer it to its parent (C) as its alpha value. So C has alpha = 3. C will be no smaller than 3.

5. Repeat this process, descending to C’s great grandchildren (0) in a depth-first fashion. D is alpha-pruned, because no matter what happens on its right branch, it cannot be greater than 0.

6. Repeating on E, E is alpha-pruned because its beta value (2) is less than its parent’s alpha value (3). So no matter what happens on its right branch, E cannot have a value greater than 2.

7. Therefore C is 3.
HAVE A GOOD WEEKEND