**Midterm review**

• Uninformed search

• Breadth first search • Depth first search

• Uniform cost search • Iterative deepening search

• bidirectional search

Generic Tree-Search Algorithm

Add **initial state** to the **frontier**

Loop

**node = remove-frontier**( ) -- and save in order to return as part of path to **goal**

if **goal-test(node) = true** return path to **goal**

**S = successors(node**)

Add **S to frontier**

until **frontier** is empty

return **failure**.

Informed search

• Greedy Best-First Search

• Expands the node that is “ closest” to the goal as measured by h(n)

• A\* search

• Combining Uniform-Cost Search and Greedy Best-First Search• f(n) = g(n) + h(n)

• g(n): the path cost from the start node to node n

Diagram

Description automatically generated• h(n): the estimated cost of the cheapest path from node n to the goal node.

**• Uniform-cost** orders by path cost g(n)

**• Greedy best first search** orders by estimated goal proximity h(n)

**• A\* search** combines g(n) and h(n).

• If h is **admissible**, then the A\* tree search is optimal

• If h is **consistent**, then the A\* **graph search** is optimal

Hill Climbing Search

• Move in the direction of increasing value

• Terminate when it reaches a “ peak” where no neighbor has a higher value.

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State-Space Landscape

• Local Search Methods rely on an objective function or a cost functionto compute the state-space landscape

Diagram

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• Local search algorithms explore this landscape

Improvements to Basic Local Search

• Issue: How to move more quickly to successively higher plateaus and avoid getting “ stuck” / local minima

• Idea: Introduce uphill moves (“ noises”) to escape from long plateaus (or true local minima).

• Strategies:

• Simulated Annealing

• Random-restart hill-climbing

• Tabu search

• Local beam search

• Genetic Algorithms

Genetic Algorithm

Diagram

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Crossover Operators

•Single-point crossover:

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Mutation

• Mutation: randomly flip one bit

A screenshot of a computer

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Machine Learning

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Neural Networks

• Neural networks consist of a collection of nodes which model biological neurons in human brain.

• Neural networks have one input layer, one or multiple hidden layers and one output layer.

Diagram, schematic

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What are learnt by neural networks

Diagram

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Deep Neural Networks: The Success

Graphical user interface

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Practical Deployment

Graphical user interface

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Transfer Learning

Shape

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Few-shot Learning

N-way K-shot few-shot learning task:

• Each task has a total of N classes.

• Each class has K examples.

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Sequential Tasks

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Diagram

Description automatically generatedLifelong Learning

• Regularization based approach

- Prevent **important weights** for old tasks from changing drastically.

• Knowledge transfer based method

- Build **connections** between the models for the new task and old tasks.

• Episodic memory based approach

- Store **a small subset of examples** from old tasks

Semantic Segmentation

Timeline

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