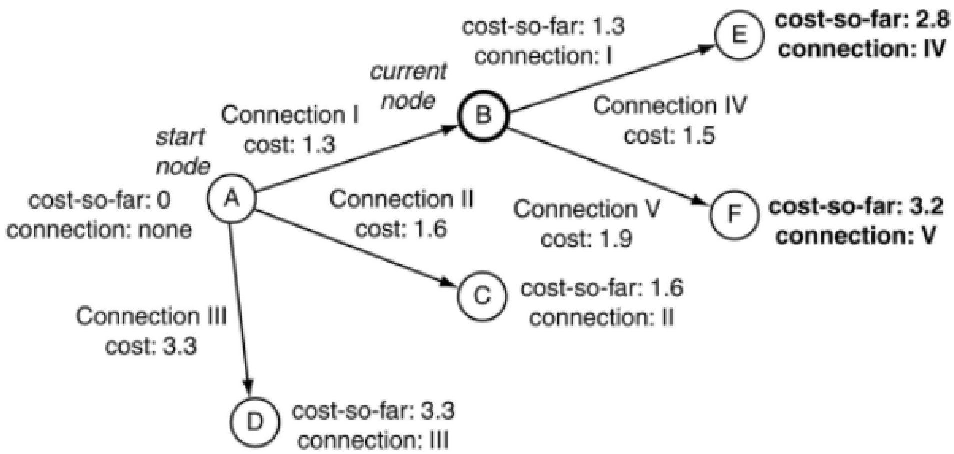
Dijkstra's Algorithm

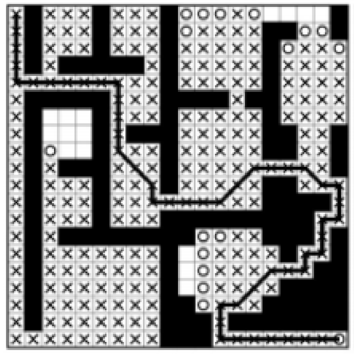


Imagine we are running Dijkstra's shortest path algorithm on the graph in the picture. If nodes A and B have been explored, which node will get explored next?

- (a) F
- (b) C
- (c) E
- (d) D

Indoor Pathfinding

Indoor Level



Which method would be the best choice for pathfinding in an indoor game level?

- ○ (a) A* with the Euclidean heuristic
- ○ (b) Dijkstra's shortest path algorithm
- ○ (c) A* with the cluster heuristic
- ○ (d) A* with the Null heuristic

Inverse Kinematics

Which of the following are true for animation using inverse kinematics?

- [ ] (a) Once it is constructed the Jacobian matrix can be re-used for each new motion and frame the animator indicates.
- [ ] (b) Usnig IK, animators can specify a motion for a whole skeleton just by changing the position of an end effector (e.g. an ankle or finger).
- [ ] (c) The system of partial differential equations will have an analytical solution.
- [ ] (d) The system of partial differential equations may not have a unique solution, meaning multiple different poses could generated from the same end effector motion.

Select all possible options that apply. ?

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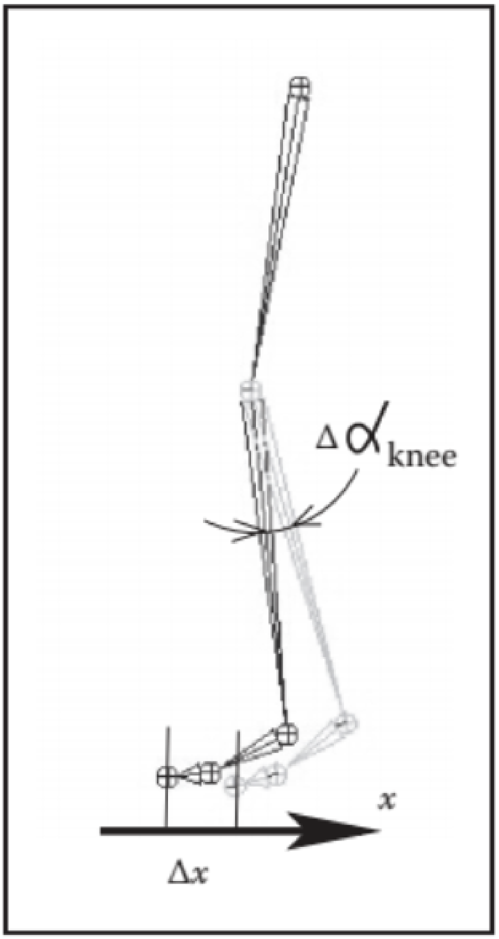
Inverse Kinematics and the Jacobian

Suppose that we want to use inverse kinematics on the skeleton in the diagram. Imagine we move the toe effector at the very bottom of the model, in which the top effector is the root. When we construct a Jacobian matrix to solve for the positions of all the internal joints, what will the shape of the Jacobian be?

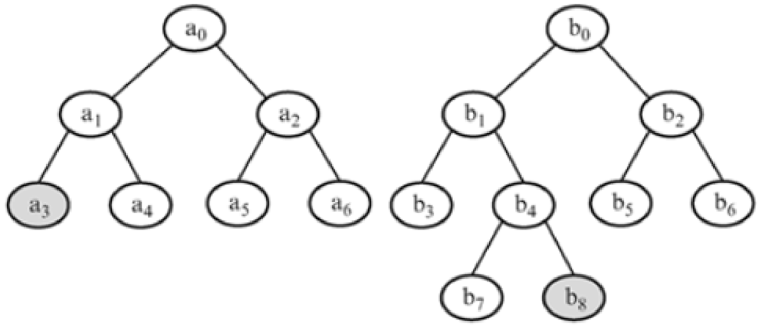


Assume we account for the position of each effector in the Jacobian matrix and that coordinates are specified in 3D space and we are only interested in position for each joint (e.g. (x, y, z) coordinates).

Number of rows =	integer	?
Number of columns =	integer	?

Collision Detection Between BVHs

For the following questions, refer to the image below:



We have two objects $\mathbf{a}$ and $\mathbf{b}$, each with their own BVH as shown below. Each node has a bounding volume associated with it. Suppose only the geometry in nodes a_4 and b_5 are in collision. What is the minimal number of bounding volume intersection tests that might be needed to determine this? This means you should assume there are no false positive bounding box intersection tests.

integer

Suppose instead that the only geometry in collision is in nodes a_4 and b_5 **but all the bounding volumes of all the nodes are in collision** (so you get the maximum number of false positives). How many bounding volume intersection tests are performed in that case?

integer

Euler Integration 1

Suppose Euler integration is used to generate particle positions in a simple Newtonian physics particle simulation. Which of the following would be associated with larger error in the computed positions?

- (a) A smaller timestep
- (b) A larger timestep
- (c) Particles with large accelerations
- (d) Both a smaller timestep and large acceleration
- (e) Both larger acceleration particles and a larger timestep

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Physics Engine with Euler Integration

Imagine you implement a physics engine and are animating a particle.

At time $t = 0$, a particle begins at position $\begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$

It is moving with velocity $\begin{bmatrix} 3 \\ 0 \\ 2 \end{bmatrix}$ per second. It has acceleration $\begin{bmatrix} 2 \\ -1 \\ -2 \end{bmatrix}$ per second per second.

Using Euler integration, with a timestep of 1 second, what is the position of the particle at time $t = 2$ seconds (i.e. after 2 time steps)?

Assume that acceleration is constant.

Assume that in each time step, updating position happens before updating velocity.

Enter your answer as integer values (NO decimal point)!

$\begin{bmatrix} \square \\ \square \\ \square \end{bmatrix}$?

Save & Grade | Save only | New variant

A* Grid

The image below contains a grid that shows costs associated with cells on a map. Let's suppose that the cells of cost 1 are flat grassland while the cells of cost 3 are more mountainous areas.

1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	3	1	1	1	1	1	1	1
1	1	1	3	3	3	3	3	3	1	3	3	1
1	1	1	1	3	3	3	1	1	1	1	1	1
1	1	1	1	1	3	3	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	3	1	1	1	1	1	3	1	3
3	3	1	3	3	1	3	3	1	3	3	3	3
1	1	1	3	3	1	1	1	1	3	3	3	3
1	1	1	1	3	1	1	1	1	1	3	1	3
1	1	1	1	1	1	1	1	1	1	1	1	1

If we wanted to speed up A* would we artificially increase or decrease the costs of the mountainous areas?

- ○ (a) increase
- ○ (b) decrease

Why?

- ○ (a) Lower cost makes A* choose flatlands more often than mountainous areas
- ○ (b) Lower cost makes A* less computationally intense
- ○ (c) Higher cost makes A* choose flatlands more often than mountainous areas
- ○ (d) Higher cost makes A* less computationally intense

What is the downside of making the change?

- ○ (a) A* may run slower due to very small numbers
- ○ (b) A* may run slower due to very large numbers
- ○ (c) A* may miss a potentially better path by going through mountainous areas
- ○ (d) A* may miss a potentially better path by not choosing mountainous areas