1. Breadth first search

Air Cargo Problem 1

- Expansions: 43
- Goal Tests: 56
- New Nodes: 180
- Plan length: 6
- Execution time: 0.03547631500987336 seconds

```
Load(C1, P1, SFO)
Load(C2, P2, JFK)
Fly(P2, JFK, SFO)
Unload(C2, P2, SFO)
Fly(P1, SFO, JFK)
Unload(C1, P1, JFK)
```

Air Cargo Problem 2

- Expansions: 3346
- Goal Tests: 4612
- New Nodes: 30534
- Plan length: 9
- Execution time: 81.65928123100002 seconds

```
Load(C1, P1, SFO)
Load(C2, P2, JFK)
Load(C3, P3, ATL)
Fly(P1, SFO, JFK)
Unload(C1, P1, JFK)
Fly(P2, JFK, SFO)
Unload(C2, P2, SFO)
Fly(P3, ATL, SFO)
Unload(C3, P3, SFO)
```

Air Cargo Problem 3

- Expansions: 14663
- Goal Tests: 18098
- New Nodes: 129631
- Plan length: 12
- Execution time: 457.6173511959996 seconds

```
Load(C1, P1, SFO)
Load(C2, P2, JFK)
Fly(P2, JFK, ORD)
Load(C4, P2, ORD)
```

```
Fly(P1, SFO, ATL)
Load(C3, P1, ATL)
Fly(P1, ATL, JFK)
Unload(C1, P1, JFK)
Unload(C3, P1, JFK)
Fly(P2, ORD, SFO)
Unload(C2, P2, SFO)
Unload(C4, P2, SFO)
```

2. Breadth first tree search

Air Cargo Problem 1

- Expansions: 1458
- Goal Tests: 1459
- New Nodes: 5960
- Plan length: 6
- Execution time: 6.019270433000202 seconds

```
Load(C1, P1, SFO)
Load(C2, P2, JFK)
Fly(P2, JFK, SFO)
Unload(C2, P2, SFO)
Fly(P1, SFO, JFK)
Unload(C1, P1, JFK)
```

Air Cargo Problem 2

Does not terminate in 10 minutes.

Air Cargo Problem 3

Does not terminate in 10 minutes.

3. Depth first graph search

Air Cargo Problem 1

- Expansions: 21
- Goal Tests: 22
- New Nodes: 84
- Plan length: 20
- Execution time: 0.09816352300003928 seconds

```
Fly(P1, SFO, JFK)
Fly(P2, JFK, SFO)
```

```
Load(C2, P1, JFK)
Fly(P1, JFK, SFO)
Fly(P2, SFO, JFK)
Unload(C2, P1, SFO)
Fly(P1, SFO, JFK)
Fly(P2, JFK, SFO)
Load(C2, P2, SFO)
Fly(P1, JFK, SFO)
Load(C1, P2, SFO)
Fly(P2, SFO, JFK)
Fly(P1, SFO, JFK)
Unload(C2, P2, JFK)
Unload(C1, P2, JFK)
Fly(P2, JFK, SFO)
Load(C2, P1, JFK)
Fly(P1, JFK, SFO)
Fly(P2, SFO, JFK)
Unload(C2, P1, SFO)
```

Air Cargo Problem 2

- Expansions: 107
- Goal Tests: 108
- New Nodes: 959
- Plan length: 105
- Execution time: 2.255084823999823 seconds

```
Fly(P3, ATL, JFK)
Fly(P2, JFK, ATL)
Fly(P3, JFK, SFO)
Fly(P2, ATL, SFO)
Fly(P1, SFO, ATL)
Fly(P3, SFO, ATL)
Fly(P1, ATL, JFK)
Fly(P3, ATL, JFK)
...
Unload(C2, P3, SFO)
```

Air Cargo Problem 3

- Expansions: 408
- Goal Tests: 409
- New Nodes: 3364
- Plan length: 392
- Execution time: 11.076630202999695 seconds

```
Fly(P1, SFO, ORD)
Fly(P2, JFK, ORD)
```

```
Fly(P1, ORD, ATL)
Fly(P2, ORD, ATL)
Fly(P1, ATL, JFK)
Fly(P2, ATL, SFO)
...
Unload(C3, P1, JFK)
```

4. Depth limited search

Air Cargo Problem 1

- Expansions: 101
- Goal Tests: 271
- New Nodes: 414
- Plan length: 50
- Execution time: 0.48083225499794935 seconds

```
Load(C1, P1, SFO)
Load(C2, P2, JFK)
Unload(C1, P1, SFO)
Load(C1, P1, SFO)
Unload(C1, P1, SFO)
Load(C1, P1, SFO)
Unload(C1, P1, SFO)
...
Unload(C1, P1, JFK)
```

Air Cargo Problem 2

Does not terminate in 10 minutes.

Air Cargo Problem 3

Does not terminate in 10 minutes.

5. Uniform cost search

Air Cargo Problem 1

- Expansions: 55
- Goal Tests: 57
- New Nodes: 224
- Plan length: 6
- Execution time: 0.2418411139951786 seconds

```
Load(C1, P1, SFO)
Load(C2, P2, JFK)
Fly(P1, SFO, JFK)
Fly(P2, JFK, SFO)
Unload(C1, P1, JFK)
Unload(C2, P2, SFO)
```

Air Cargo Problem 2

- Expansions: 4853
- Goal Tests: 4855
- New Nodes: 44041
- Plan length: 9
- Execution time: 140.8912663539959 seconds

```
Load(C1, P1, SFO)
Load(C2, P2, JFK)
Load(C3, P3, ATL)
Fly(P1, SFO, JFK)
Fly(P2, JFK, SFO)
Fly(P3, ATL, SFO)
Unload(C3, P3, SFO)
Unload(C2, P2, SFO)
Unload(C1, P1, JFK)
```

Air Cargo Problem 3

Does not terminate in 10 minutes.

6. Recursive best first search with h1 heuristic function

Air Cargo Problem 1

- Expansions: 4229
- Goal Tests: 4230
- New Nodes: 17023
- Plan length: 6
- Execution time: 17.971775871999853 seconds

```
Load(C2, P2, JFK)
Load(C1, P1, SFO)
Fly(P2, JFK, SFO)
Unload(C2, P2, SFO)
Fly(P1, SFO, JFK)
Unload(C1, P1, JFK)
```

Air Cargo Problem 2

Does not terminate in 10 minutes.

Air Cargo Problem 3

Does not terminate in 10 minutes.

7. Greedy best first graph search with h_1

Air Cargo Problem 1

- Expansions: 7
- Goal Tests: 9
- New Nodes: 28
- Plan length: 6
- Execution time: 0.02786448599999858 seconds

```
Load(C1, P1, SFO)
Load(C2, P2, JFK)
Fly(P1, SFO, JFK)
Fly(P2, JFK, SFO)
Unload(C1, P1, JFK)
Unload(C2, P2, SFO)
```

Air Cargo Problem 2

- Expansions: 998
- Goal Tests: 1000
- New Nodes: 8982
- Plan length: 21
- Execution time: 26.12001982899983 seconds

```
Load(C1, P1, SFO)
Load(C2, P2, JFK)
Load(C3, P3, ATL)
Fly(P1, SFO, ATL)
Fly(P2, JFK, ATL)
Fly(P3, ATL, JFK)
Fly(P2, ATL, SFO)
Unload(C2, P2, SFO)
Fly(P2, SFO, ATL)
Fly(P3, JFK, SFO)
Load(C2, P3, SFO)
Fly(P3, SFO, JFK)
Fly(P1, ATL, JFK)
Unload(C1, P1, JFK)
```

```
Load(C1, P3, JFK)
Fly(P1, JFK, ATL)
Fly(P3, JFK, SFO)
Unload(C3, P3, SFO)
Unload(C2, P3, SFO)
Fly(P3, SFO, JFK)
Unload(C1, P3, JFK)
```

Air Cargo Problem 3

- Expansions: 5614
- Goal Tests: 5616
- New Nodes: 49429
- Plan length: 22
- Execution time: 259.74592149100044 seconds

```
Load(C1, P1, SFO)
Load(C2, P2, JFK)
Fly(P1, SFO, ORD)
Load(C4, P1, ORD)
Fly(P2, JFK, ATL)
Load(C3, P2, ATL)
Fly(P2, ATL, ORD)
Fly(P1, ORD, ATL)
Unload(C4, P1, ATL)
Fly(P1, ATL, ORD)
Fly(P2, ORD, ATL)
Load(C4, P2, ATL)
Fly(P2, ATL, ORD)
Unload(C3, P2, ORD)
Load(C3, P1, ORD)
Fly(P1, ORD, JFK)
Unload(C3, P1, JFK)
Unload(C1, P1, JFK)
Fly(P1, JFK, ORD)
Fly(P2, ORD, SFO)
Unload(C4, P2, SFO)
Unload(C2, P2, SFO)
```

8. A* search with h1 heuristic function

Air Cargo Problem 1

- Expansions: 55
- Goal Tests: 57
- New Nodes: 224
- Plan length: 6

- Execution time: 0.25108054200245533 seconds

```
Load(C1, P1, SFO)
Load(C2, P2, JFK)
Fly(P1, SFO, JFK)
Fly(P2, JFK, SFO)
Unload(C1, P1, JFK)
Unload(C2, P2, SFO)
```

Air Cargo Problem 2

- Expansions: 4853
- Goal Tests: 4855
- New Nodes: 44041
- Plan length: 9
- Execution time: 162.15786768100224 seconds

```
Load(C1, P1, SFO)
Load(C2, P2, JFK)
Load(C3, P3, ATL)
Fly(P1, SFO, JFK)
Fly(P2, JFK, SFO)
Fly(P3, ATL, SFO)
Unload(C3, P3, SFO)
Unload(C2, P2, SFO)
Unload(C1, P1, JFK)
```

Air Cargo Problem 3

- Expansions: ?
- Goal Tests: ?
- New Nodes: ?
- Plan length: ?
- Execution time: ? seconds

```

```

9. A* search with h_ignore_preconditions

Air Cargo Problem 1

- Expansions: 41
- Goal Tests: 43
- New Nodes: 170
- Plan length: 6
- Execution time: 0.042065354995429516 seconds

```

```

```
Load(C1, P1, SFO)
Fly(P1, SFO, JFK)
Unload(C1, P1, JFK)
Load(C2, P2, JFK)
Fly(P2, JFK, SFO)
Unload(C2, P2, SFO)
```

Air Cargo Problem 2

- Expansions: 1506
- Goal Tests: 1508
- New Nodes: 13820
- Plan length: 9
- Execution time: 13.943244863010477 seconds

```
Load(C3, P3, ATL)
Fly(P3, ATL, SFO)
Unload(C3, P3, SFO)
Load(C2, P2, JFK)
Fly(P2, JFK, SFO)
Unload(C2, P2, SFO)
Load(C1, P1, SFO)
Fly(P1, SFO, JFK)
Unload(C1, P1, JFK)
```

Air Cargo Problem 3

- Expansions: 5118
- Goal Tests: 5120
- New Nodes: 45650
- Plan length: 12
- Execution time: 93.62522890602122 seconds

```
Load(C2, P2, JFK)
Fly(P2, JFK, ORD)
Load(C4, P2, ORD)
Fly(P2, ORD, SFO)
Unload(C4, P2, SFO)
Load(C1, P1, SFO)
Fly(P1, SFO, ATL)
Load(C3, P1, ATL)
Fly(P1, ATL, JFK)
Unload(C3, P1, JFK)
Unload(C2, P2, SFO)
Unload(C1, P1, JFK)
```

10. A* search with levelsum heuristic function

Air Cargo Problem 1

- Expansions: 7
- Goal Tests: 9
- New Nodes: 28
- Plan length: 6
- Execution time: 0.9002755659894319 seconds

```
Load(C1, P1, SFO)
Load(C2, P2, JFK)
Fly(P1, SFO, JFK)
Fly(P2, JFK, SFO)
Unload(C1, P1, JFK)
Unload(C2, P2, SFO)
```

Air Cargo Problem 2

- Expansions: 77
- Goal Tests: 79
- New Nodes: 760
- Plan length: 9
- Execution time: 129.23260724698775 seconds

```
Load(C1, P1, SFO)
Fly(P1, SFO, JFK)
Load(C2, P2, JFK)
Fly(P2, JFK, SFO)
Load(C3, P3, ATL)
Fly(P3, ATL, SFO)
Unload(C3, P3, SFO)
Unload(C2, P2, SFO)
Unload(C1, P1, JFK)
```

Air Cargo Problem 3

Does not terminate in 10 minutes.