

## **Agenda for Today — Planning and Search**

- Planning Application Example
- Dependency-Directed Backtracking
- Exploiting Constraints
- If-Add-Delete Operators (STRIPS)
- Review: Any Search Questions?

## **You will be expected to know:**

- Dependency-Directed Backtracking
- How does it differ from Chronological Backtracking?
- When can it be used?
- Role of Constraints
- There is a larger planning literature ...

## Chronological Backtracking vs. Dependency-directed Backtracking

- Operators correspond to a choice about how the world is going to change.
- Backtracking corresponds to withdrawing that choice, and undoing any changes.
- Chronological backtracking (DFS) always undoes the most RECENT choice.
- Dependency-directed backtracking always undoes the most recent choice THAT COULD MAKE A DIFFERENCE.
- Chronological backtracking is a special case of Dependency-directed backtracking in which there is NO KNOWLEDGE — consequently, the most recent choice COULD make a difference, because you have no knowledge that it does not.
- More Knowledge = Less Search  
Add Knowledge — Reasons for Failure

Mon Exer (1, 2):      0/\$0    5/\$0    10/\$0    15/\$20

Mon Enter (2, 4):    0/\$0    1/\$0    2/\$20

Tue Study (3):            0        2        4        6

Wed Study (3):            0        2        4        6

Thu Study (3):            0        2        4        6

Fri Exer (1, 2):      0/\$0    5/\$0    10/\$0    15/\$20

Fri Enter (2, 4):      0/\$0    1/\$0    2/\$20

**CONSTRAINTS:**

(1) Exercise  $\geq$  20:

(2) Money  $\leq$  30:

(3) Study  $\geq$  6:

(4) Pleasure  $\geq$  2:

## **Triangle Puzzle**

9! = 362,880 combinations

## Triangle Puzzle — DFS

Choose A,

Choose B,

Choose C,

....,

Choose I,

Goal Test

## Triangle Puzzle — Constraints

$$A + B + C + D + E + F + G + H + I = 45$$

$$A + B + C + D = D + E + F + G = G + H + I + A = p$$

$$\Rightarrow 2A + B + C + 2D + E + F + 2G + H + I = 3p$$

$$\Rightarrow A + D + G = 3p - 45$$

$$\Rightarrow A + D + G \text{ divisible by } 3$$

## Triangle Puzzle — Search Exploiting Constraints

Choose A,

Choose D,

Choose G, /\*  $A + D + G$  divisible by 3 \*/

set  $p \leftarrow (A + D + G + 45)/3$

Choose B, /\*  $C = p - A - B - D$  \*/

Choose E, /\*  $F = p - D - E - G$  \*/

/\*  $H + I = p - A - G$  \*/