Recap

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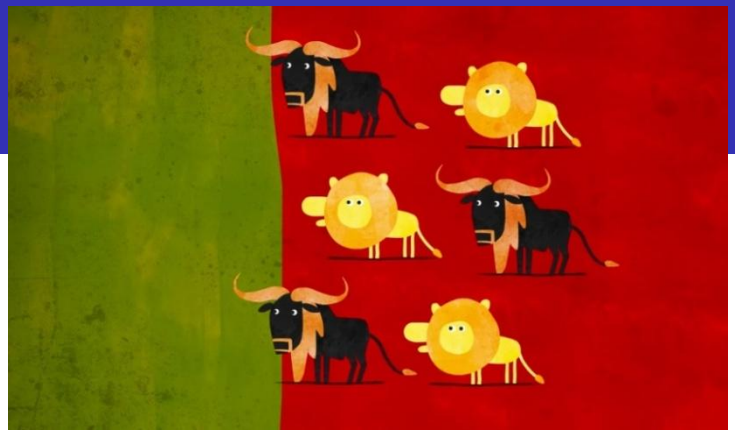
MCGW Challenge

- MCGW graph has 10 nodes, with 4 constraints.
  - Wolf and goat cannot stay together without man.
  - Goat and cabbage cannot stay together without man.
  - Boat can only carry at most 2 entities.
  - Only man can row the boat.
- There are two best solutions.

Easy

MCGW Challenge



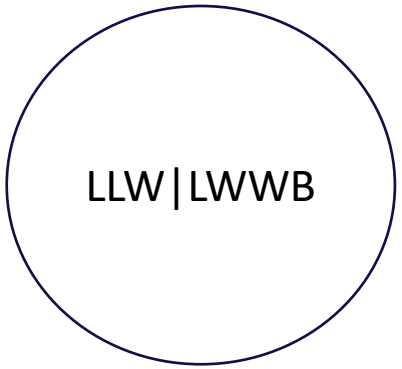
- Consider the lion and wildebeest problem.
  - 3 lions and 3 wildebeests need to cross the river.
  - Boat can carry at most two animals.
  - All can row the boat.
  - If number of lions is more than number of wildebeests on any side of the river, the lions will eat the wildebeests.
- Can you solve this problem?
  - What information should be stored in a node?
  - How many nodes are there in the graph?

Medium

MCGW Challenge – Node Information

- In each node, we need:
  - The number of lions and wildebeests on each side
  - The position of the boat

E.g.



MCGW Challenge – How many nodes?

- How many possible states are there (valid or invalid)?

- Lions (4): LLL|, LL|L, L|LL, |LLL
- Wildebeests (4): WWW|, WW|W, W|WW, |WWW
- Boat (2): B|, |B

- 4 x 4 x 2 = 32 possible states

MCGW Challenge – How many nodes?

- How many valid states are there?
  - If number of lions is more than number of wildebeests on any side of the river, the lions will eat the wildebeests
- Let's start with the left side of the river.
  - 3 Lions: LLLWWW| or LLL|
  - 2 Lions: LLWW| or LLWWW| or LL|
  - 1 Lion: LW| or LWW| or LWWW| or L|
  - 0 Lions: W| or WW| or WWW| or |

MCGW Challenge – How many nodes?

- How many valid states are there?
  - If number of lions is more than number of wildebeests on any side of the river, the lions will eat the wildebeests
- Fill in the right side
  - 3 Lions: LLLWWW| or LLL|WWW
  - 2 Lions: LLWW|LW or LLWWW|L or LL|LWWW
  - 1 Lion: LW|LLWW or LWW|LLW or LWWW|LL or L|LLWWW
  - 0 Lions: W|LLLWW or WW|LLLW or WWW|LLL or |LLLWWW

MCGW Challenge – How many nodes?

- How many valid states are there?
  - If number of lions is more than number of wildebeests on any side of the river, the lions will eat the wildebeests
- Remove invalid states
  - 3 Lions: LLLWWW| or LLL|WWW
  - 2 Lions: LLWW|LW or LLWWW|L or LL|LWWW
  - 1 Lion: LW|LLWW or ~~LWW|LLW~~ or LWWW|LL or L|LLWWW
  - 0 Lions: ~~W|LLLWW~~ or ~~WW|LLLW~~ or WWW|LLL or |LLLWWW

MCGW Challenge – How many nodes?

- How many valid states are there?
  - If number of lions is more than number of wildebeests on any side of the river, the lions will eat the wildebeests
- x2 for each valid state for boat position
  - 3 Lions: LLLWWW| or LLL|WWW
  - 2 Lions: LLWW|LW or LLWWW|L or LL|LWWW
  - 1 Lion: LW|LLWW or LWWW|LL or L|LLWWW
  - 0 Lions: WWW|LLL or |LLLWWW
- 20 valid states!

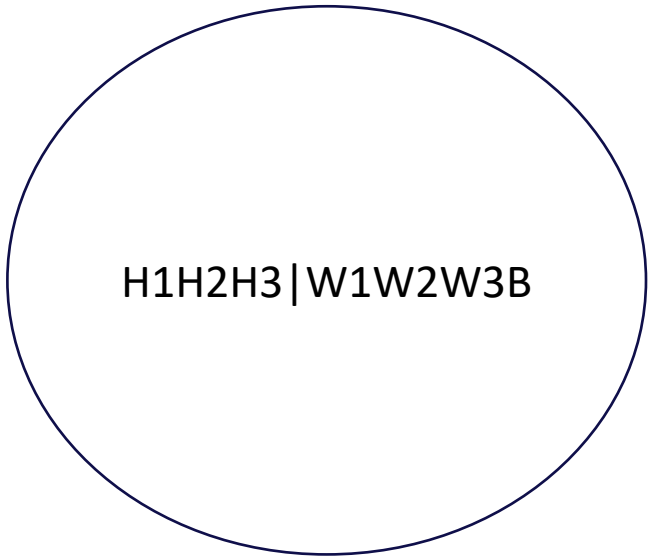
MCGW Challenge

- Consider the three couples problem.
  - 3 husbands and 3 wives need to cross the river.
  - Boat can hold at most two persons.
  - All can row the boat.
  - If a wife is not with her husband, other husbands there will do bad thing.
- Can you solve this problem?
  - What information should be stored in a node?
  - How many nodes are there in the graph?

Hard

MCGW Challenge – Node Information

- Label husbands as H1, H2, H3, and Wives as W1, W2, W3.
- Node needs to have position of husbands, wives, and boats
- E.g.



MCGW Challenge – How many nodes?

- How many possible states are there (valid or invalid)?
- Each of the 6 people can be on either side.
  - 2^6
- The boat can be on either side
- $2 \times 2^6 = 128$ possible states!

MCGW Challenge – How many nodes?

- How many valid states are there?
  - If a wife is not with her husband, other husbands there will do bad thing.
  - In other words, if a wife is not with her husband, and any other husband is present, the state is invalid.

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That's all Folks!