Data Structures and Algorithms (1)

Instructor: Ming Zhang

Textbook Authors: Ming Zhang, Tengjiao Wang and Haiyan Zhao

Higher Education Press, 2008.6 (the "Eleventh Five-Year" national planning textbook)

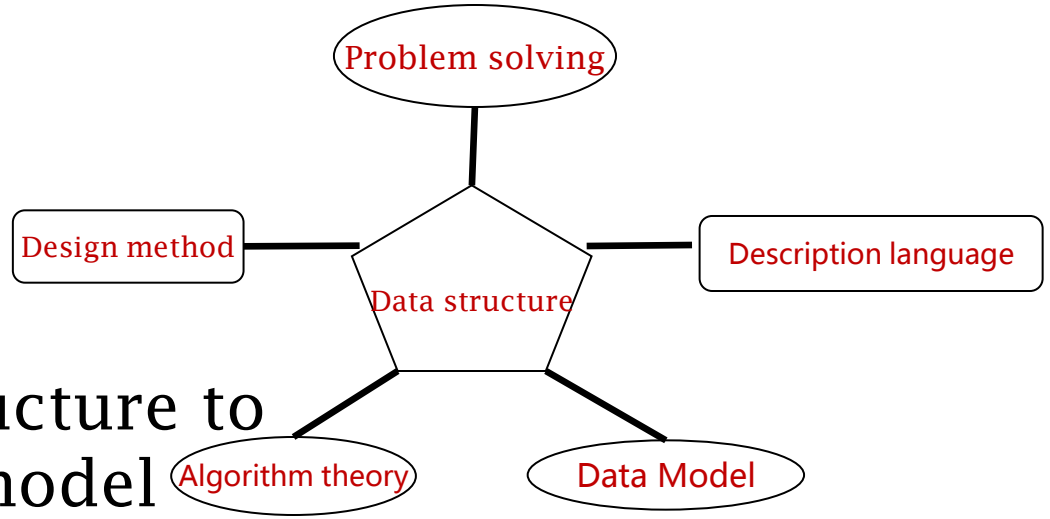
https://courses.edx.org/courses/PekingX/04830050x/2T2014/

Chapter 1 Overview

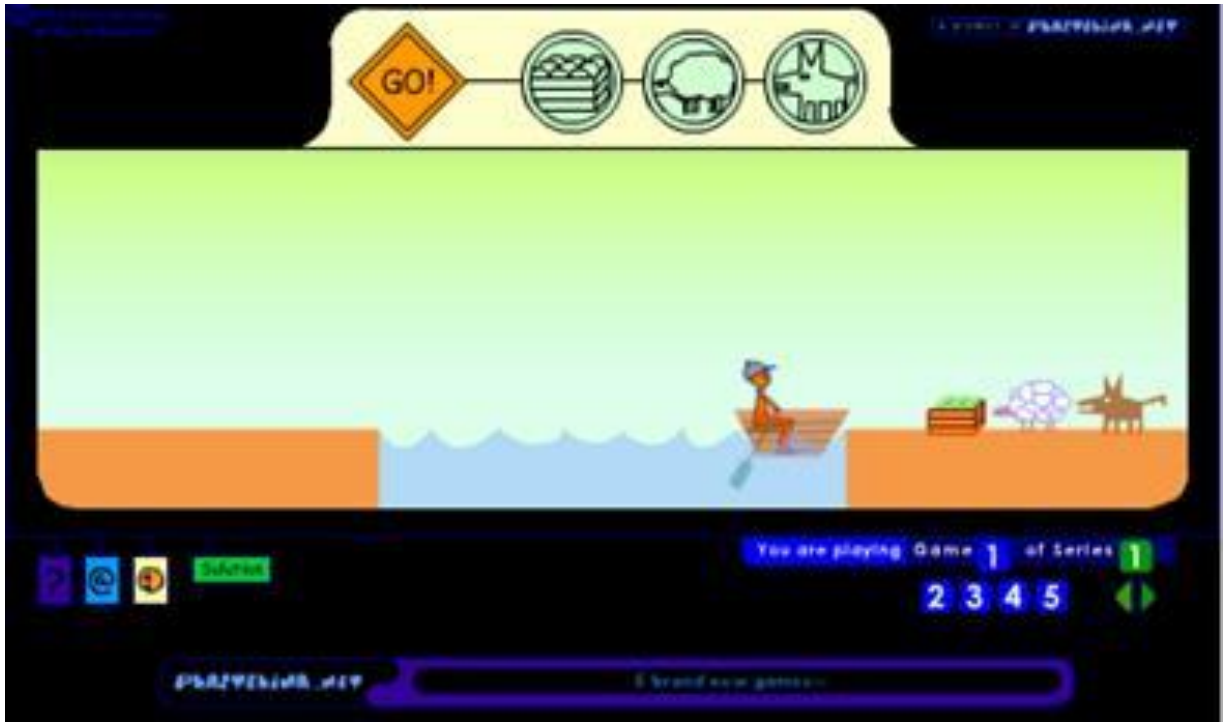
- Problem solving
- Data structures and abstract data types
- The properties and categories of algorithms
- Evaluating the efficiency of the algorithms

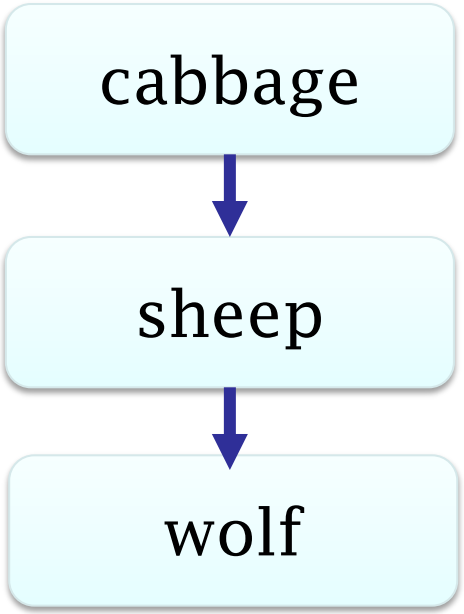
1.1 Problem solving

- Goal of writing computer programs ?
  - To solve practical problems
- Problem Abstraction
  - Analyze requirements and build a problem model
- Data Abstraction
  - Determine an appropriate data structure to represent a certain mathematical model
- Algorithm Abstraction
  - Design suitable algorithms for the data model
- Data structures + Algorithms => Programs
  - Simulate and solve practical problems



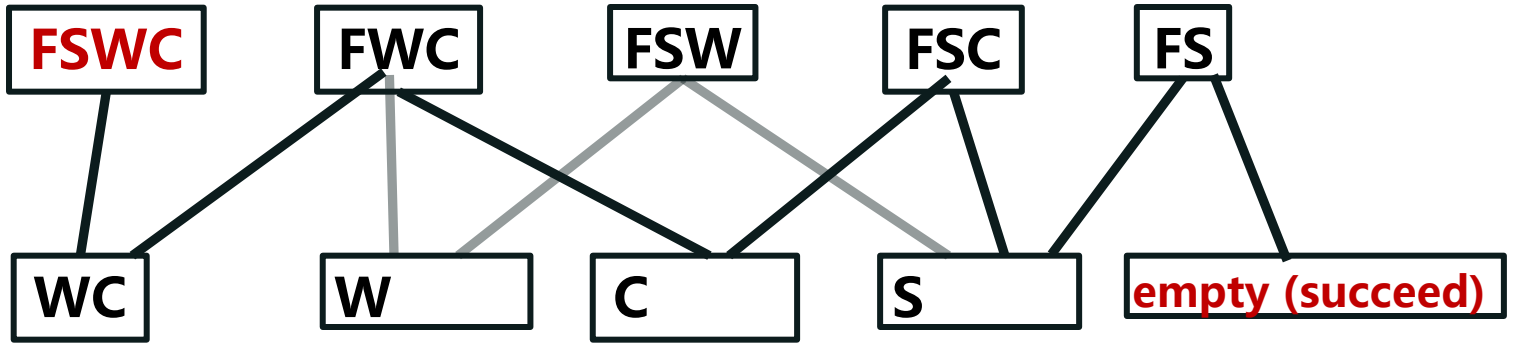
Farmer Crosses River Puzzle



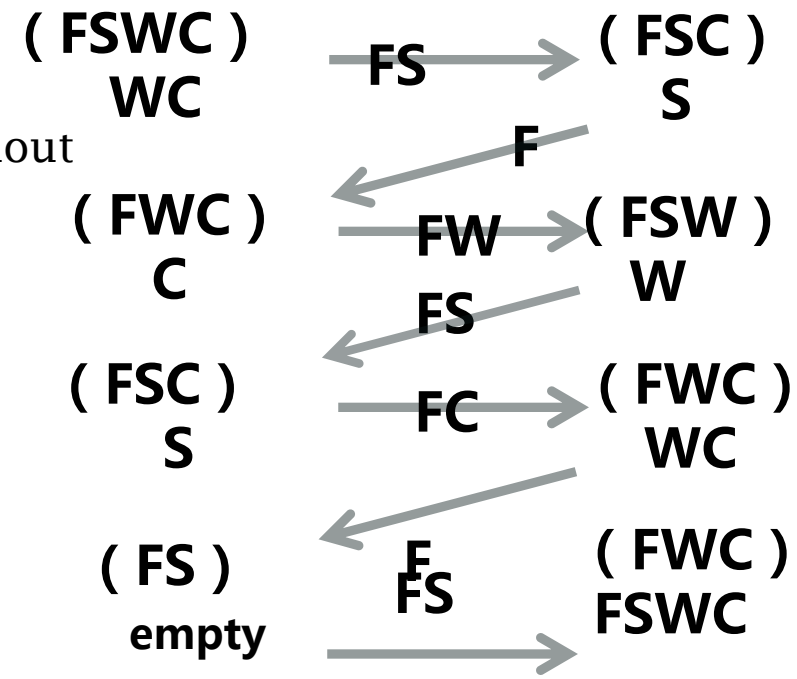


1.1 Problem solving

- **Problem abstraction** : FSWC crossing over the river
  - Only the farmer can row the boat
  -There are only two seats on the boat including the farmer
  - “Wolf and sheep”, “sheep and cabbages” can not stay along without the accompany of the farmer
- **Data abstraction** : graph model
  - Unreasonable state : WS、FC、SC、FW、WSC、F
  - The vertex represents the “original bank status”(10 states, including “empty”)
  - edge : state transition as the result of a reasonable operation (cross over the river)



Farmer Crosses River Puzzle



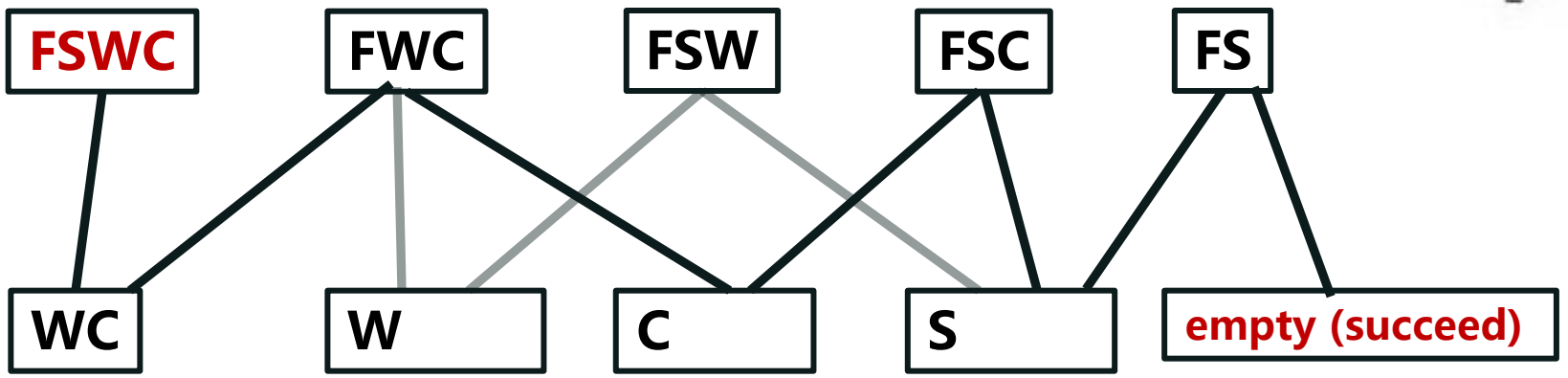
Farmer is abbreviated as F
Sheep is abbreviated as S
Wolf is abbreviated as W
cabbage is abbreviated as C

1.1 Problem solving

Farmer Crosses River Puzzle

- Data structure
  - Adjacency matrix
- Algorithm abstraction :
  - The shortest path

$$\begin{bmatrix}
0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 1 & 1 & 1 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 1 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 \\
1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 1 & 1 & 1 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0
\end{bmatrix}$$



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Questions : process of problem solving

- Farmer Crosses River Puzzle —— The shortest path model
  - Problem abstraction ?
  - Data abstraction?
  - Algorithm abstraction ?
  - You may write programs to achieve it.

- Any other model ?

Data Structures and Algorithms

Thanks

the National Elaborate Course (Only available for IPs in China)
http://www.jpk.pku.edu.cn/pkujpk/course/sjjg/

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