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Presentation of solutions

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The Nutty Professor

```
System.out.println(d+n(p-s)>0?"do not parallelize":
                   d+n(p-s);<0?"parallelize":"does not matter");
```

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The Traveling Orienteerer

- Read coordinates into $X[0...n-1]$ and $Y[0...n-1]$
- For each route $P_1, \ldots, P_p$:
  - Sum distances between consecutive control points P_i and P_{i+1}:
    - $\sqrt{(X[P_{i+1}] - X[P_i])^2 + (Y[P_{i+1}] - Y[P_i])^2}$

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Traffic Load

- Put the hits on the left and right chord in sorted sets L and R.
- As long as there are hits not accounted for:
  - If a first is $t \in L$:
    - Count one from the left.
    - Remove $t \in L$, $t + 500 \in L$, $t + 1000 \in R$, $t + 1500 \in R$.
  - Or the first is $t \in R$:
    - Count one from the right.
    - Remove $t \in R$, $t + 500 \in R$, $t + 1000 \in L$, $t + 1500 \in L$.

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The Still Embarrassed Cryptographer

Example

- $S = \texttt{CRYPTO}$
- $T = \texttt{CPTOYR}$
- Application:
  - $\text{crypt}^1(\texttt{CRYPTO}) = \texttt{CPTOYR}$
  - $\text{crypt}^2(\texttt{CRYPTO}) = \texttt{COYRTP}$
  - $\text{crypt}^3(\texttt{CRYPTO}) = \texttt{CRTPYO}$
  - $\text{crypt}^4(\texttt{CRYPTO}) = \texttt{CPYOTR}$
  - $\text{crypt}^5(\texttt{CRYPTO}) = \texttt{COTRYP}$
  - $\text{crypt}^6(\texttt{CRYPTO}) = \texttt{CRYPTO}$
- Permutation contains cycles (C), (R,P,O) and (Y,T).
- $\text{lcm}(1, 3, 2) = \text{lcm}(\text{lcm}(1, 3), 2) = 6$
- $6 - 1 = 5$

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TV Battle

— Observation: there are a lot of shows (possibly 100000), but only 10080 seconds in a week.

— The following recursive formula is thus a good basis for a solution based on dynamic programming:

$$mf(t) = \max \begin{cases} mf(t-1) \\ mf(t - dur(s)) + fun(s) \quad \text{for shows with } end(s) = t \end{cases}$$

— Use the above formula in bottum-up dp (for example) and you have a correct solution.

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Vampire

— Calculate chance of at least y successes with x throws.

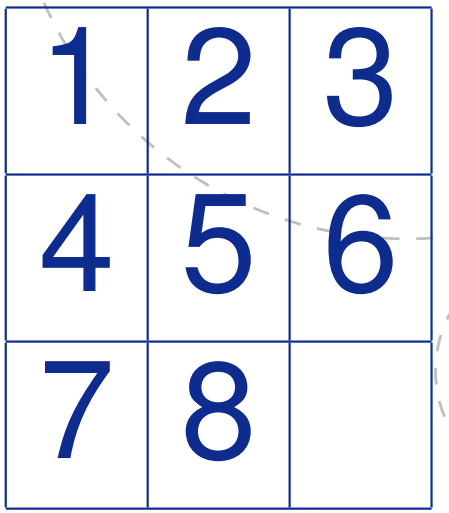
$$\mathrm{P}(x,y) = \begin{cases} 1 & \text{if } y = 0 \\ 0 & \text{else if } x = 0 \\ 0.1 \cdot \mathrm{P}(x, y-1) + & \\ 0.2 \cdot \mathrm{P}(x-1, y-1) + & \\ 0.7 \cdot \mathrm{P}(x-1, y) & \text{otherwise} \end{cases}$$

— Memoize function.

Eight Puzzle

Representation of state

- Array rather than matrix.
- Integer (123456789) rather than array.



Solution

- Set up legal moves for blank:
  - $1 \rightarrow \{2, 4\}$, $2 \rightarrow \{1, 5, 3\}$, etc..
- BFS from goal state 123456789.
- Note distance to each reachable state.
- For each input problem:
  - Translate to integer presentation.
  - Print distance if reachable.

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Paper

Solution

— Each expr. has a signature from 2^3 different inputs of $\mathrm{x}, \mathrm{y}, \mathrm{z}$

— $2^{(2^3)}$ different sigs.

— BFS from sigs of x, y and y.

- Need only remember shortest for each signature.

— Example $e \leftarrow (f \mid g)$:

- $e.\mathrm{sig} := f.\mathrm{sig} \mid g.\mathrm{sig}$
- $e.\mathrm{size} := 1 + f.\mathrm{size} + 1 + g.\mathrm{size} + 1$

— String representation of no use.

— Generate exprs. in order of length.

- Do not need to store size explicitly.
- Store only sigs as ints.

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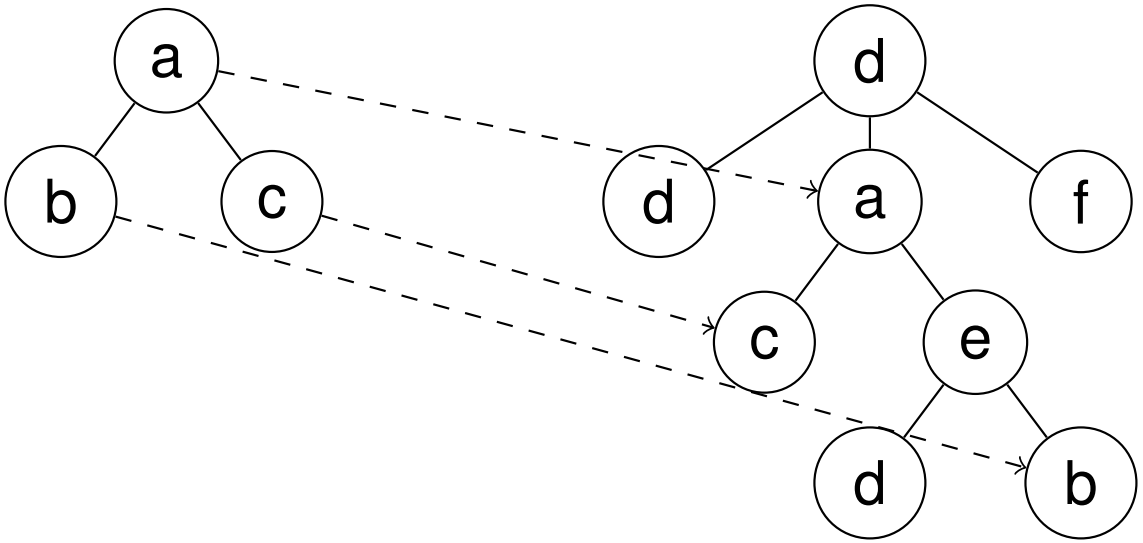
Tree of Pain

— Find injective mapping f from tree P to tree T.
  - $f(u) = f(v)$ iff $u = v$,
  - $label(u) = label(f(u))$, and
  - u is an ancestor of v iff $f(u)$ is an ancestor of $f(v)$.

— Complexity of Unordered Tree Inclusion? Sweet reduction from SAT. Buy me a beer and I'll show you.



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Tree of Pain

- Bottom-up traversal of T.
- Maintain S, set of set of pattern nodes p matchable at t.
  - $S_1, \ldots, S_q$ at child number $1, \ldots, q$ of t respectively.
  - If $s_1 \in S_1, \ldots, s_q \in S_q$:
    - $s_1 \cup \cdots \cup s_q \in S$ (cross S'es from children).
  - If $\mathrm{children}(p) \in S$ and label matches:
    - $\{p\} \in S$.
- $\mathrm{root}(P) \in S \Rightarrow$ We have a match.

Tricks

- Interested only in sets of siblings.
- `set<int>` instead of `set<set<Node*> >`
- $s_i \in S$ not interesting if $s_i \subseteq s_j \in S$.

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