Linda (or, ”Spaces”)

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Questions?

- Anything you want to say
  - Comments, questions, stray thoughts, etc.
  - Are we too fast/slow?
- Reminder – talk to your rep!
  - Feedback meeting after class
- Practical problems?
  - Don’t miss deadlines! (you’re not Douglas Adams)
  - Registration and other formalities

Comments on message passing

- Inter-process
  - Communication
  - Coordination
  - Cooperation
  - Contention
  - Concurrency
  - Synchronisation
- We mentioned simulation and examples such as pilots, athletes, dancers, musicians, …

Loosely coupled systems

- Tightly coupled systems
  - Shared memory
  - Synchronous communication
    - Whether one-to-one or broadcast
- Loosely coupled
  - Asynchronous
  - Persistent
- Linda is such a system
  - So are filing systems and databases?

Tuple space

- Large shared notice board
- Posted notes are in the form of tuples
- Can read notes matching any pattern
  - E.g., you look for a pair
    - Only singletons and triples posted
      - Block until someone posts a pair
- This blocking gives us synchronisation

Linda primitives

- Post(v1, v2, …, vn)
  - Put tuple of values out
  - Release an arbitrary proc waiting on this pattern
- Remove(X1, x2, …, Xn)
  - X's are variables and x's are constants
  - Remove an arbitrary matching note
  - Block if none available
- Read(X1, x2, …, Xn)
  - Like remove, but leave note on board

Generalisation of read and remove

- Allow patterns such as (X, 4, Y)
  - Matches only triples with middle element 4
- Allow patterns such as (X, c=, Y)
  - Where c is a variable
  - Matches only triples with middle element = c

Linda examples

- From the book
  - Slides 8.4 thru 8.7
    - Matrix multiplication using channels
  - Slides 9.1 thru 9.8
    - CS, client-server, buffer, matrix in Linda
- Given a monotonically increasing function f
  - with f(0) < 0 and f(1) > 0
  - find x where 0<x<1 such that f(x)=0.
  - Can be done by binary search
  - How to use more than one process
    - Can use ability to interrupt

The matrix example

```
| 1 2 3 |    | 1 0 2 |    | 4 2 6 |
| 4 5 6 |  X | 0 1 2 |  = | 10 5 18|
| 7 8 9 |    | 1 0 0 |    | 16 8 30|
 --   --     --   --      --   --
```

So element (3,3) of the result is

```
[7 8 9] X | 2 |
          | 2 | = 7*2 + 8*2 + 9*0 = 30
          | 0 |
          -- --
```

On Engineering

- When things go wrong
  - Shinkansen fatalities
- Stability
  - Old planes
  - Why pull is stable and push is unstable
  - New planes and proof
- One world and many departments
- Specifications, tolerances, etc.
  - Elektronik är komponenter
  - We don't even know what our nuts and bolts are
    - New disciplines need patience (and modesty)
  - The limitations of formal proofs and model checking
- Build the right system, build it right.