Optimization of a GP Application for the Cell Processor

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Outline

- Background
- Optimization for the Cell processor
- Experiments
- Conclusions

Background

- development of digital devices
  - diversification of image processing technology
    - facial recognition
    - fingerprint authentication

designed algorithms in each case
processing objective and object are confined

No general versatility

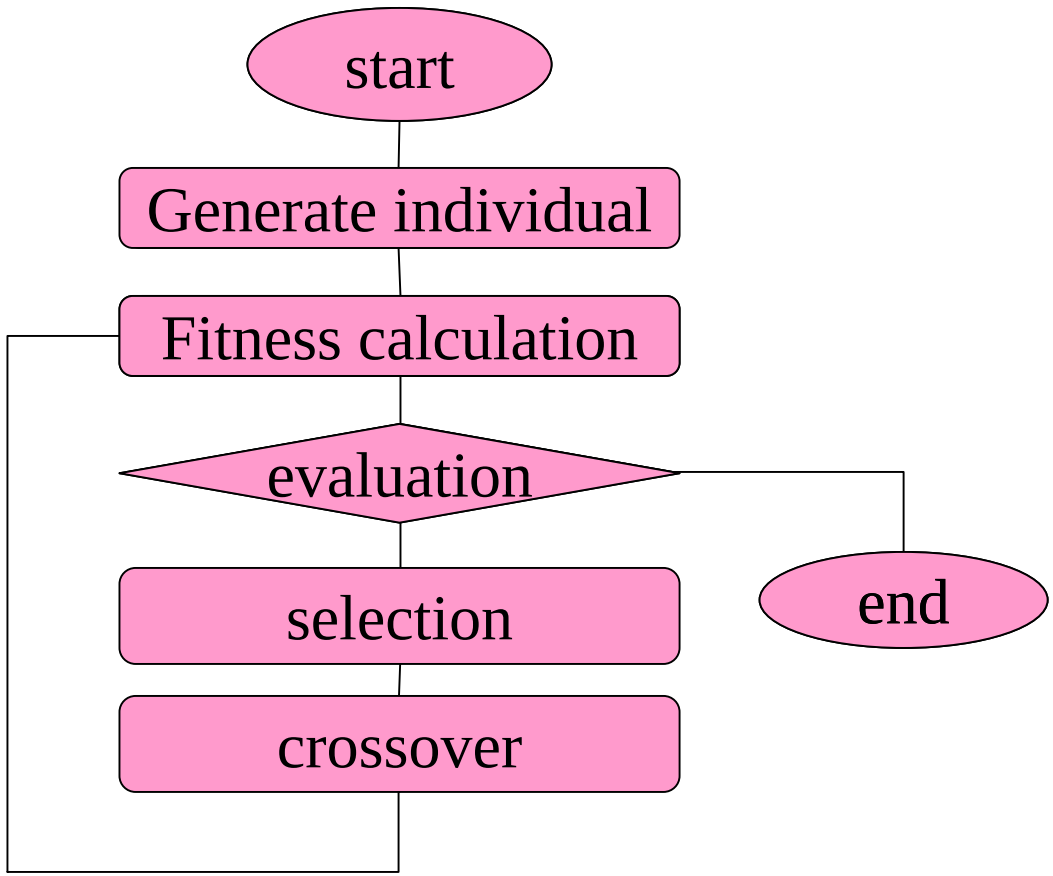
Background

- Automatic creating image processing filter
  - Genetic Programming (GP)
    - evolutionary computation
    - designing program by changing learning objective

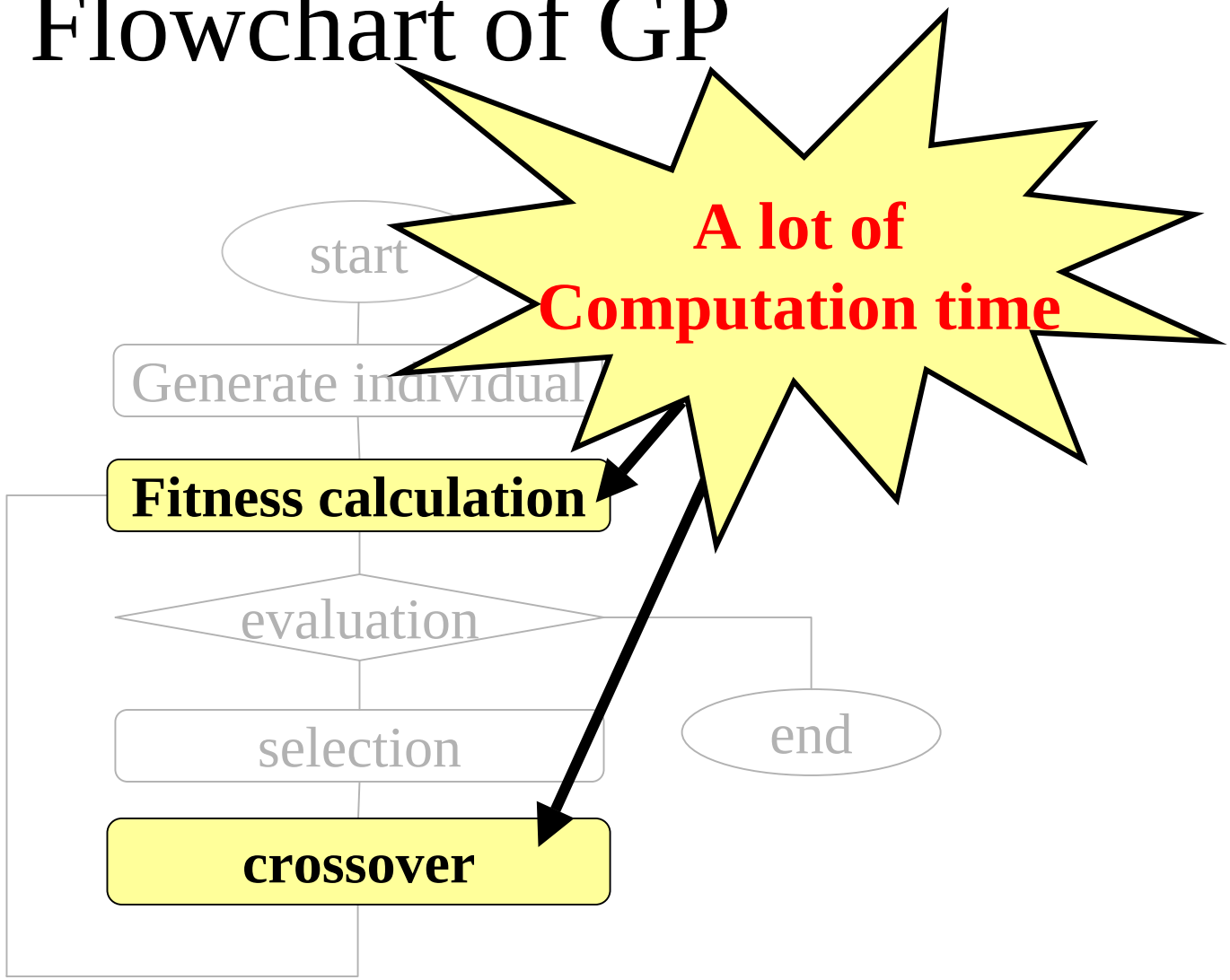
Need to speeding up

use Cell processor

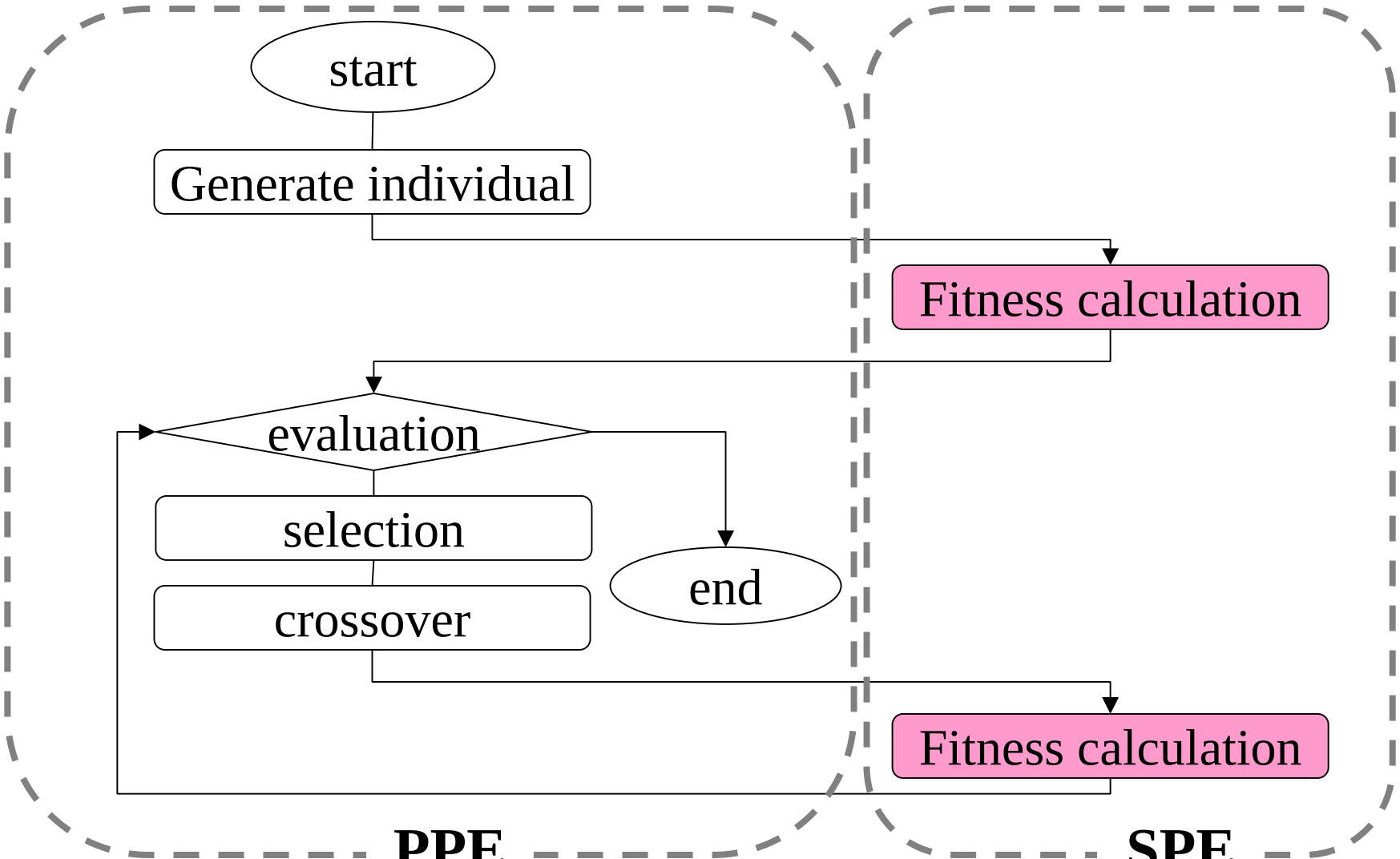
Flowchart of GP



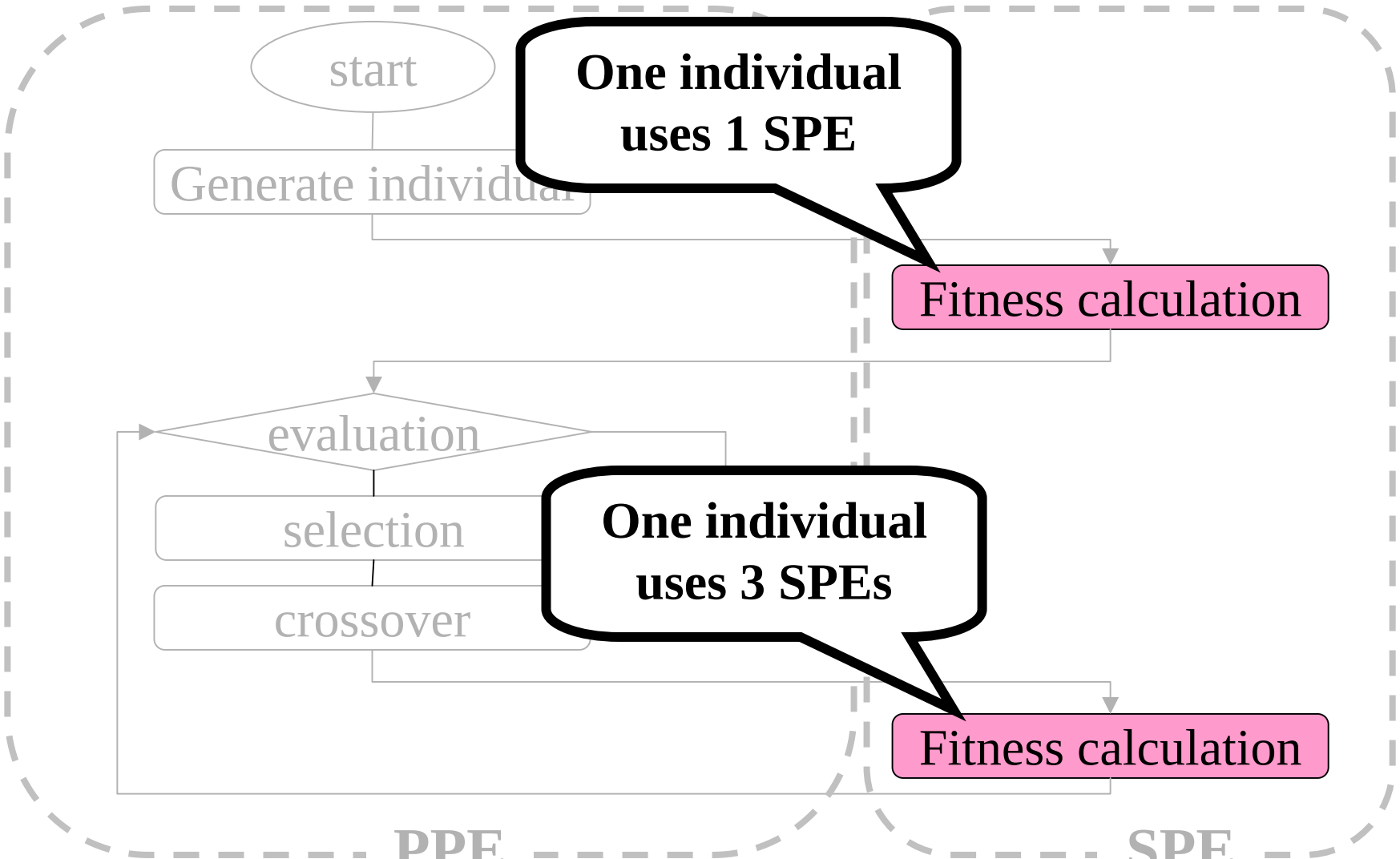
Flowchart of GP



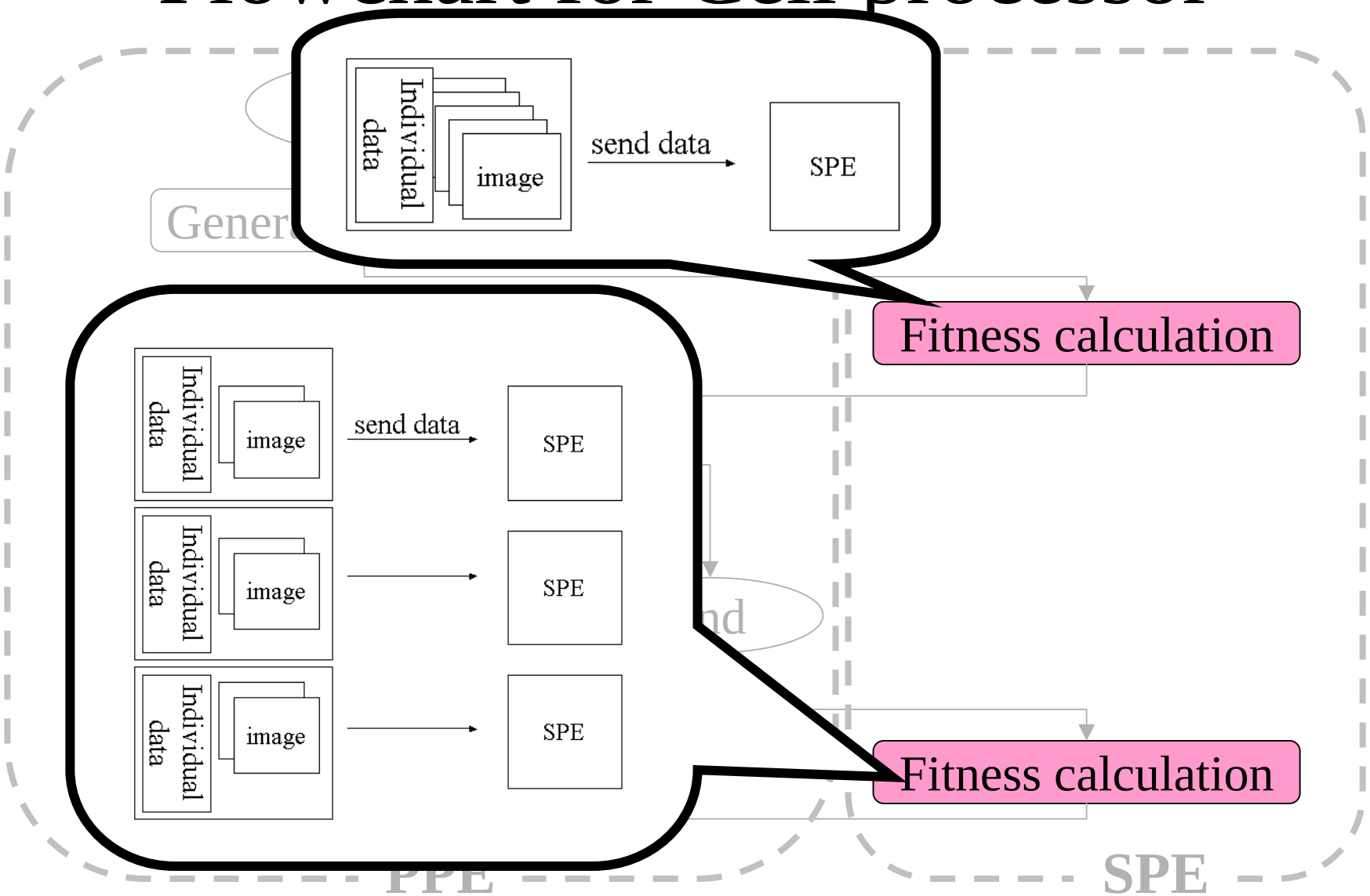
Flowchart for Cell processor



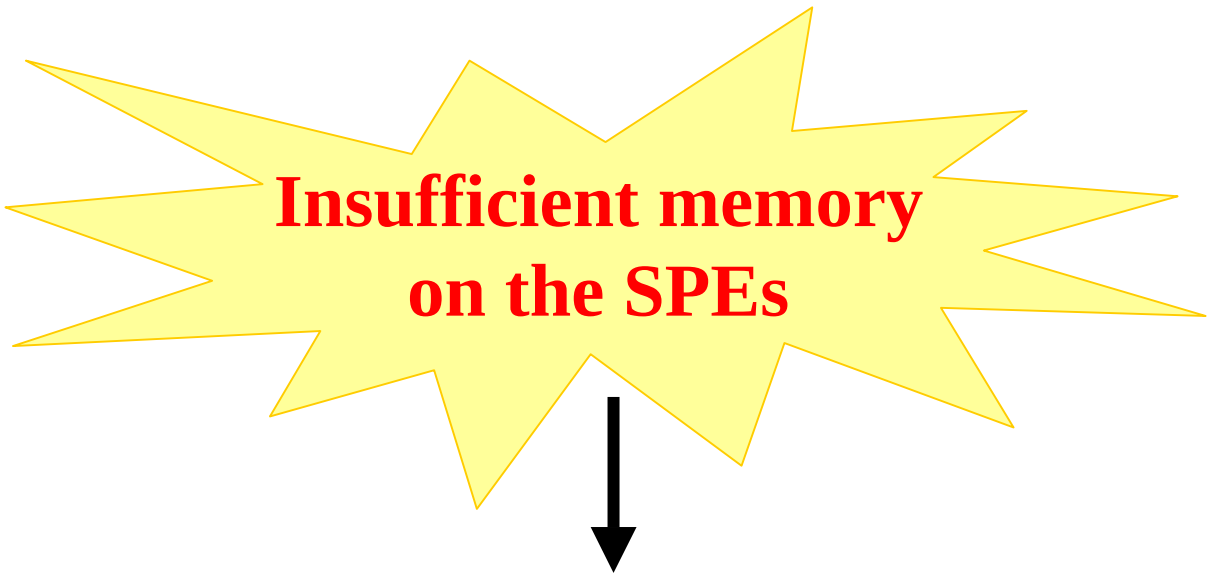
Flowchart for Cell processor



Flowchart for Cell processor



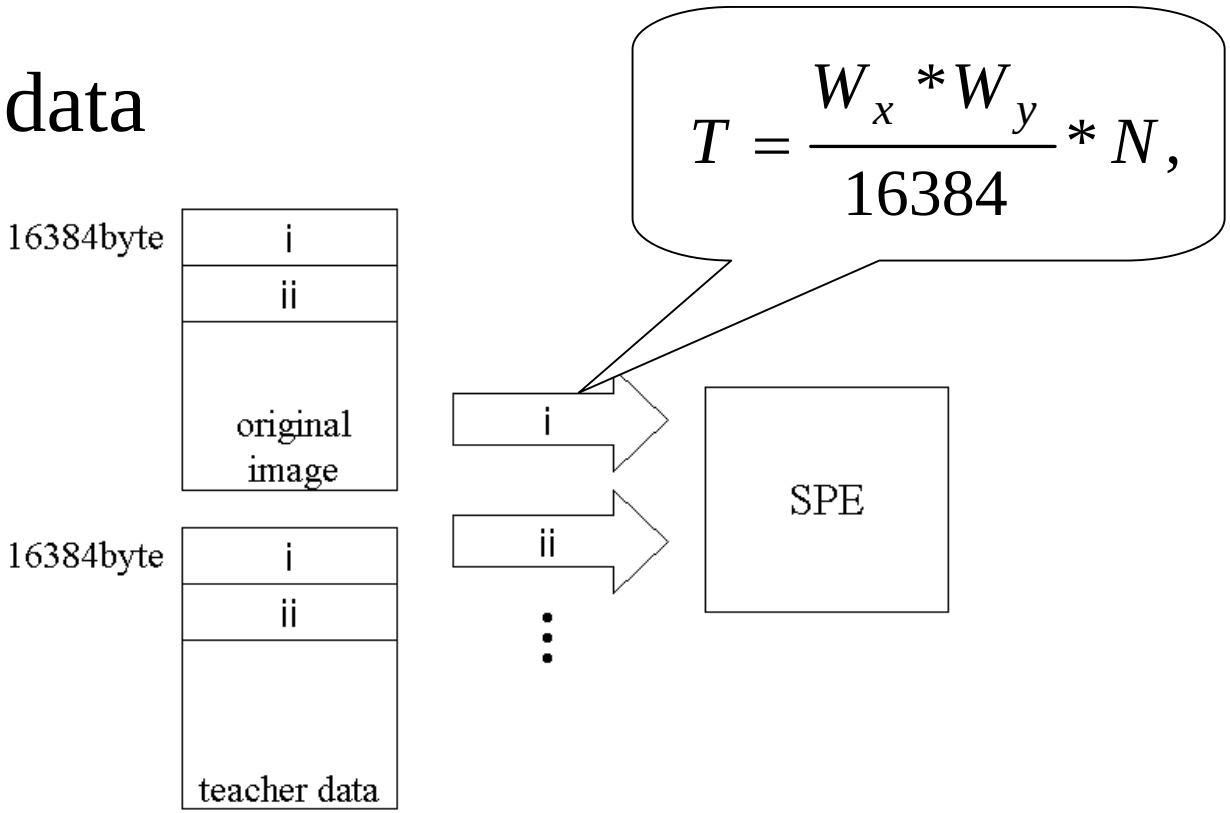
fitness calculation on the SPEs



Necessary information into array structure

fitness calculation on the SPEs

- Send data



T : number of transfers, N : number of images, Wx : image width, Wy : image height

fitness calculation on the SPEs

- SIMD

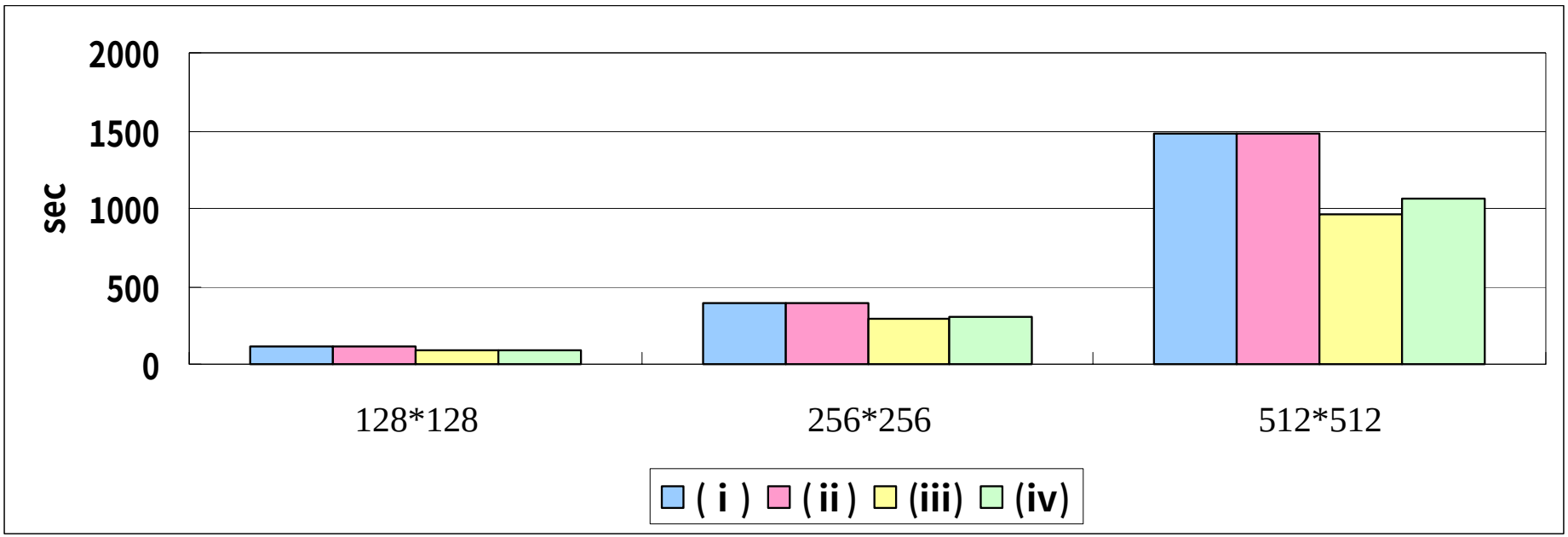
$$fitness = 1 - \frac{\sum_{x=1}^{W_x} \sum_{y=1}^{W_y} |O(x, y) - T(x, y)|}{W_x * W_y * V_{\max}}.$$

W_x:image width, W_y:image height, V_{max}:brightness value

Experiments

- Data
  - 128*128, 256*256, 512*512
- Combinations
  - PPE
  - Multi core
  - Multi core and DMA double buffering
  - Multi core and SIMD
  - Multi core, DMA double buffering, and SIMD

Results



(**i**)Multi core
(**ii**)Multi core and DMA double buffering
(**iii**)Multi core and SIMD
(**iv**)Multi core, DMA double buffering, and SIMD

Conclusions

- Optimization of a GP for the Cell processor
  - multi core, double buffering, and SIMD
- The most speeded up combination
  - Multi core and SIMD (compared to PPE)
  - 128*128 → 17 times
  - 256*256 → 25 times
  - 512*512 → 36 times

Future works

- Investigate DMA double buffering
  - Why not get effect ?
- Speeding up than now
  - SIMD
  - Crossover

Thank you for your attention !