Real-World Programming with Process and Object Data

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If we spend 1M dollar in our research project, that 1M should all be transformed into laboratory journals and data.
Annual science and technology budget

Japan: 4,200,000,000,000,000 JPY
Annual science and technology budget

Japan: 4,200,000,000,000,000 JPY

US: 124,000,000,000 USD

NIH NLM (2018): 373,000,000 USD
Object data

Process data
Process knowledge with a semantics
Process knowledge with a semantics

1. Onion → Cut
2. Carrot → Cut
3. Garlic → Cut
4. Ground beef → Cut
5. Tomato → Cut
6. Knife → Crosswise slice
7. Fry up Pan
8. Add
9. Red wine → Cabernet sauvignon
10. Add
11. Heinz
12. Chicken broth
13. Laurier
14. Nutmeg
15. Add
16. Sugar
17. Salt
18. Pepper
19. Part A

Water → Linguine
20. Add
21. Salt
22. Olive oil
23. Boil Deep pot
24. Part C
Process knowledge with a semantics

Process:
1. Onion
   - Cut
2. Carrot
   - Cut
3. Garlic
   - Cut
4. Ground beef
5. Tomato
6. Knife
   - Dice cut
7. Sugar
8. Salt
9. Pepper
10. Red wine
11. Cabernet sauvignon
12. Heinz
13. Chicken broth
14. Laurier
15. Nutmeg

Steps:
- Fry up
- Pan
- Add

Part A
Process knowledge with a semantics
LabDroid Maholo
Robotic Crowd Biology

Yachie+ Nature Biotechnology (2017)
They “clicked” the world
“Click”
“Click”
Process knowledge with a semantics
Object data

Process data