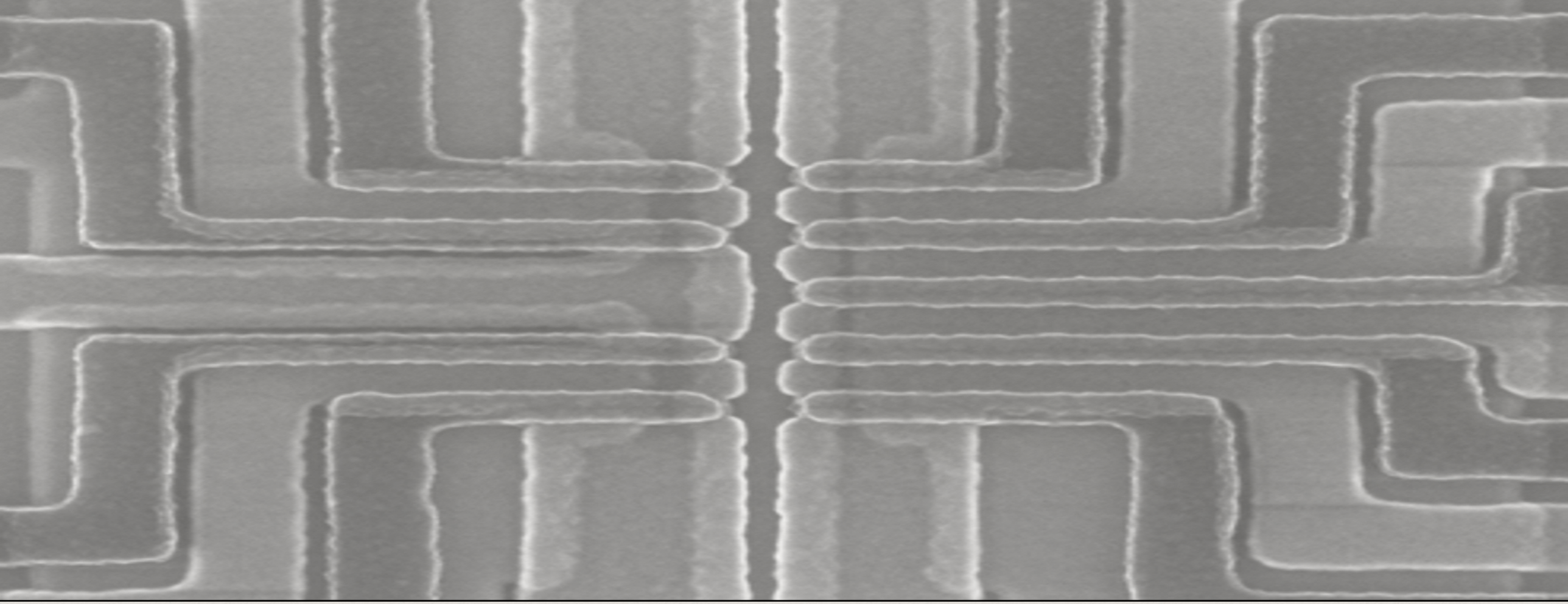
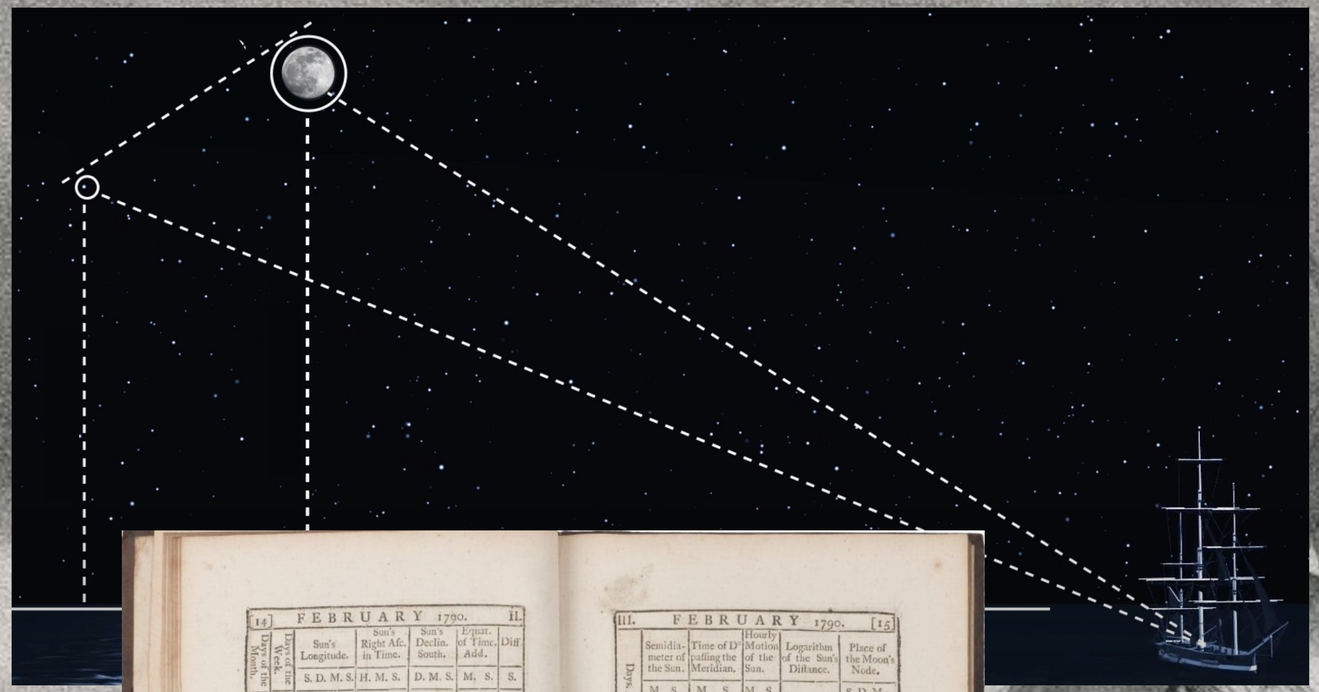


Tech for Impact 2025:
Democratising Quantum

Anasua Chatterjee
Assistant Professor
QuTech and Kavli Institute of Nanoscience,
TU Delft, Netherlands



14 FEBRUARY 1790. II.

Days of the Month.	Days of the Week.	Sun's Longitude.	Sun's Right Asc. in Time.	Sun's Declin. South.	Equat. of Time. Add.	Diff.
		S. D. M. S.	H. M. S.	D. M. S.	M. S.	S.
1	M.	10. 12. 55. 57	21. 1. 36, 8	16. 56. 59	14. 5, 9	6, 9
2	Tu.	10. 13. 50. 45	21. 5. 40, 3	16. 39. 55	14. 12, 8	6, 1
3	W.	10. 14. 53. 32	21. 9. 42, 9	16. 21. 54	14. 18, 9	5, 2
4	Th.	10. 15. 58. 18	21. 13. 44, 7	16. 3. 57	14. 24, 7	4, 4
5	F.	10. 16. 59. 3	21. 17. 45, 7	15. 45. 42	14. 28, 3	3, 7
6	Sa.	10. 17. 59. 47	21. 21. 45, 9	15. 27. 12	14. 32, 2	2, 9
7	Su.	10. 19. 0. 30	21. 25. 45, 4	15. 8. 20	14. 35, 1	2, 1
8	M.	10. 20. 1. 12	21. 29. 44, 1	14. 49. 24	14. 37, 6	1, 4
9	Tu.	10. 21. 1. 53	21. 33. 42, 0	14. 30. 8	14. 38, 8	0, 6
10	W.	10. 22. 2. 33	21. 37. 39, 2	14. 10. 37	14. 39, 2	0, 2
11	Th.	10. 23. 3. 11	21. 41. 35, 5	13. 50. 51	14. 39, 0	1, 0
12	F.	10. 24. 3. 48	21. 45. 31, 3	13. 31. 1	14. 37, 6	1, 7
13	Sa.	10. 25. 4. 24	21. 49. 26, 0	13. 10. 59	14. 36, 3	2, 4
14	Su.	10. 26. 4. 58	21. 53. 20, 1	12. 50. 24	14. 33, 9	3, 1
15	M.	10. 27. 5. 31	21. 57. 13, 5	12. 29. 36	14. 30, 8	3, 9
16	Tu.	10. 28. 6. 2	22. 1. 6, 1	12. 8. 47	14. 26, 5	4, 7
17	W.	10. 29. 6. 31	22. 4. 58, 0	11. 47. 46	14. 22, 2	5, 4
18	Th.	11. 0. 6. 58	22. 8. 49, 2	11. 26. 34	14. 16, 8	6, 0
19	F.	11. 1. 7. 24	22. 12. 39, 7	11. 5. 11	14. 10, 8	6, 7
20	Sa.	11. 2. 7. 48	22. 16. 29, 5	10. 43. 38	14. 4, 1	7, 4
21	Su.	11. 3. 8. 10	22. 20. 18, 7	10. 21. 56	13. 56, 7	8, 0
22	M.	11. 4. 8. 29	22. 24. 7, 2	10. 0. 4	13. 48, 7	8, 7
23	Tu.	11. 5. 8. 46	22. 27. 55, 1	9. 38. 4	13. 40, 6	9, 3
24	W.	11. 6. 9. 1	22. 31. 42, 3	9. 15. 53	13. 32, 1	10, 0
25	Th.	11. 7. 9. 14	22. 35. 28, 9	8. 53. 39	13. 23, 7	10, 6
26	F.	11. 8. 9. 25	22. 39. 14, 8	8. 31. 11	13. 14, 1	11, 3
27	Sa.	11. 9. 9. 34	22. 43. 0, 2	8. 8. 38	13. 4, 5	11, 9
28	Su.	11. 10. 9. 41	22. 46. 45, 1	7. 45. 58	12. 54, 8	12, 5

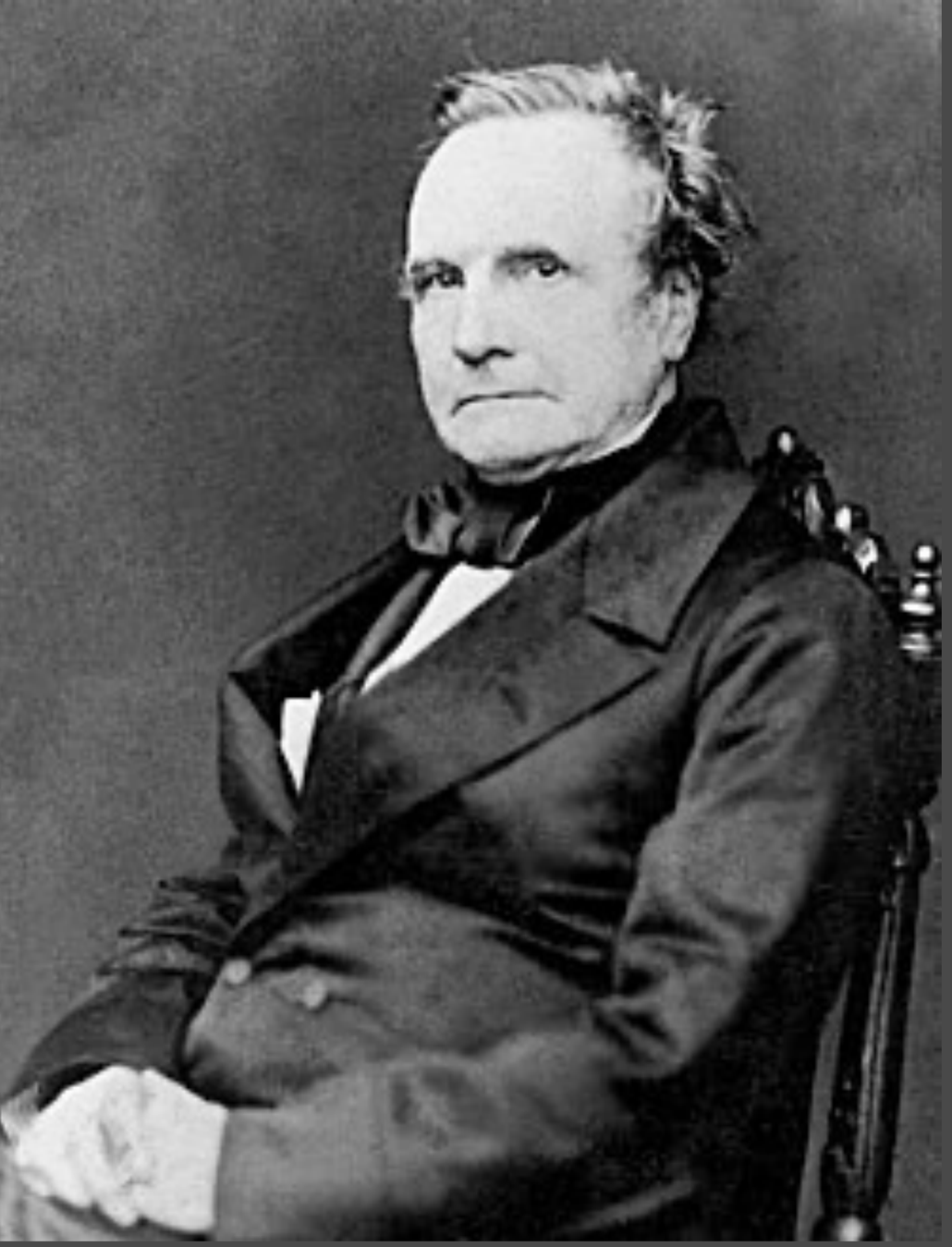
III. FEBRUARY 1790. 15

Days.	Semidiameter of the Sun.	Time of D° passing the Meridian.	Hourly Motion of the Sun.	Logarithm of the Sun's Distance.	Place of the Moon's Node.
	M. S.	M. S.	M. S.		S. D. M.
1	16. 16, 5	1. 8, 1	2. 32, 1	9. 993816	7. 14. 58
7	16. 15, 3	1. 7, 4	2. 31, 8	9. 994290	7. 14. 39
13	16. 14, 3	1. 6, 7	2. 31, 5	9. 994822	7. 14. 20
19	16. 13, 1	1. 6, 2	2. 31, 0	9. 995385	7. 14. 1
25	16. 11, 7	1. 5, 5	2. 30, 5	9. 995987	7. 13. 42

Eclipses of the Satellites of JUPITER.

I. Satellite. Immerſions.		II. Satellite. Immerſions.		III. Satellite.	
Days.	H. M. S.	Days.	H. M. S.	Days.	H. M. S.
*1	11. 40. 3	2	20. 43. 0	*7	11. 47. 19 I
3	6. 8. 19	*6	10. 0. 33	*7	15. 15. 50 E
5	0. 36. 39	9	23. 18. 19	*14	15. 45. 57 I
7	19. 5. 3	*13	12. 36. 21	14	19. 14. 4 E
*8	13. 33. 30	Emerſions.		21	19. 45. 14 I
*10	8. 1. 58	17	4. 44. 30	21	23. 13. 0 E
12	2. 30. 29	20	18. 2. 53	28	23. 45. 21 I
13	20. 59. 2	*24	7. 21. 32		
Emerſions.		27	20. 40. 30	IV. Satellite.	
*15	17. 42. 19			3	19. 30. 40 I
*17	12. 11. 38			4	0. 13. 24 E
*19	6. 40. 19			*20	13. 29. 44 I
21	1. 9. 2			20	18. 11. 16 E
22	19. 37. 46				
*24	14. 6. 34				
*26	8. 35. 24				
28	3. 4. 17				

SCIENCE MUSEUM



Charles Babbage’s Difference Engine, 1822

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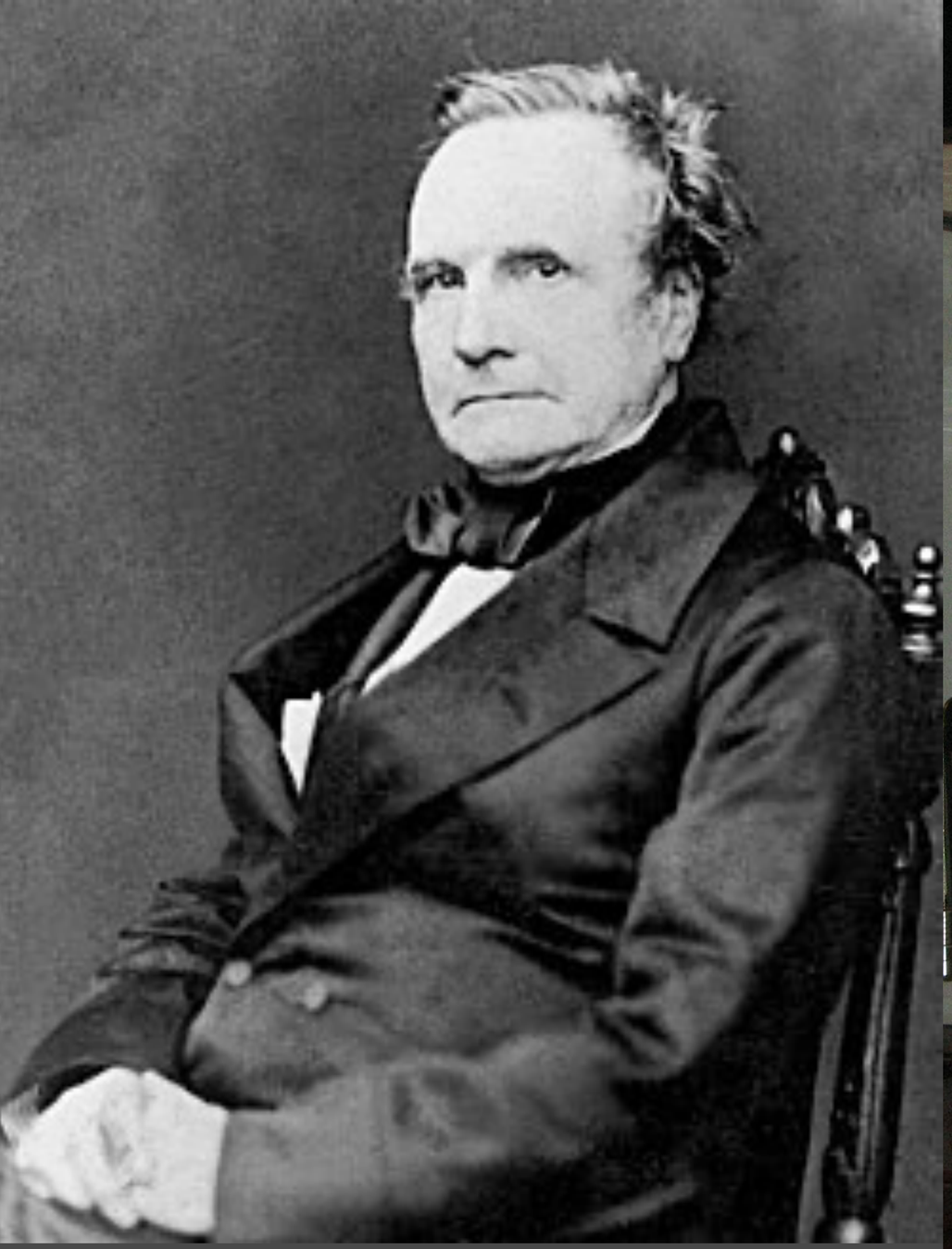
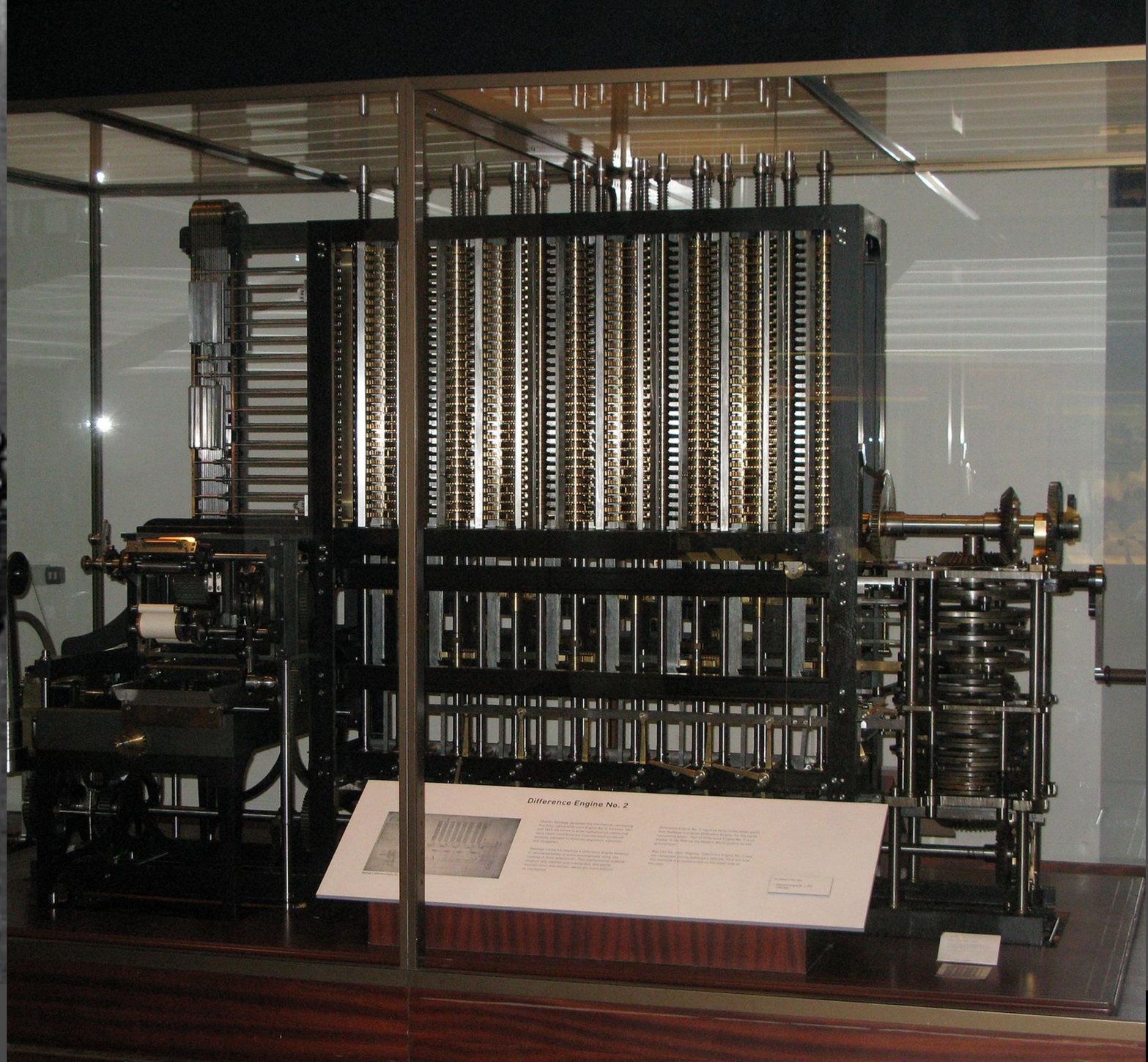
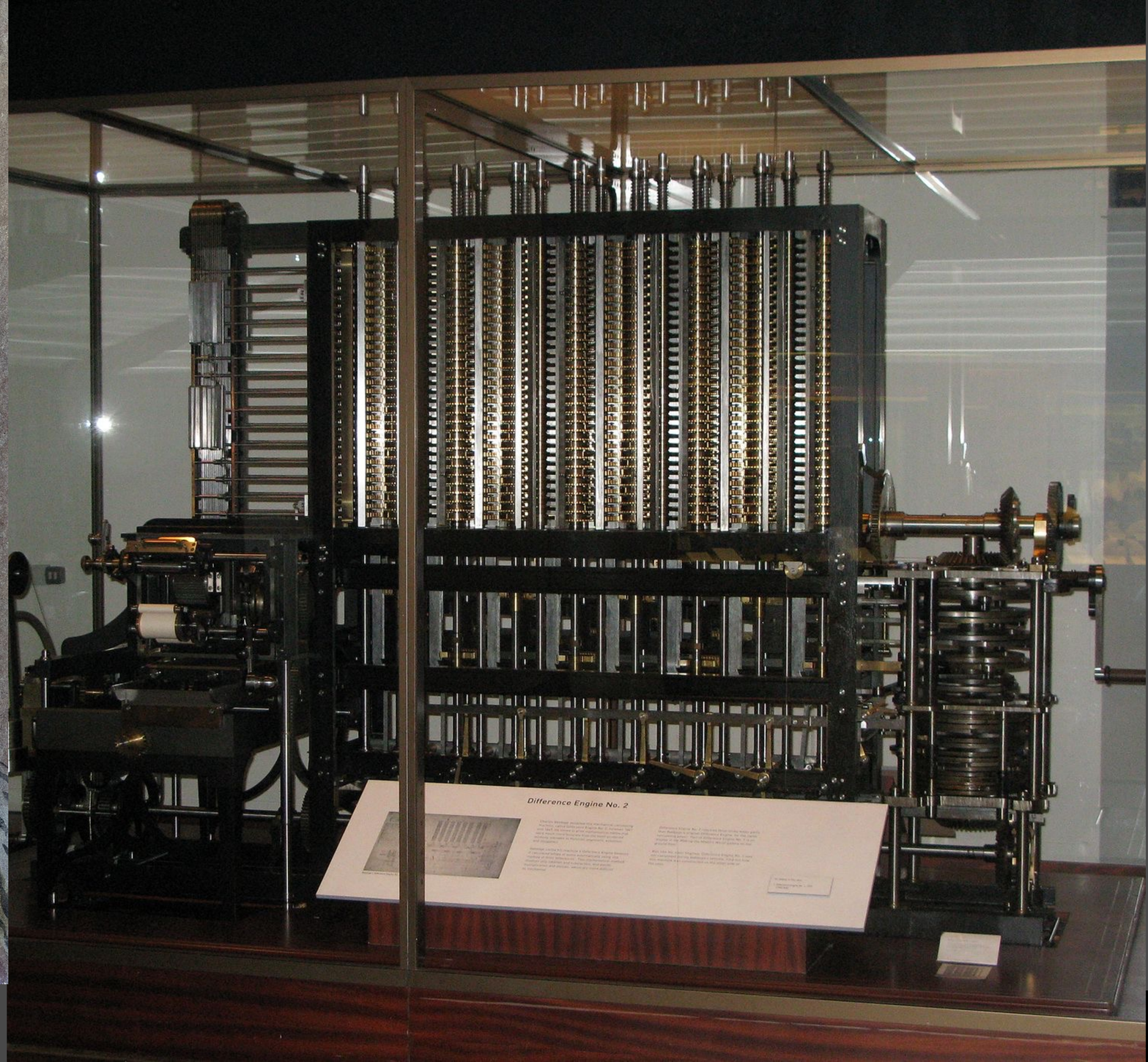
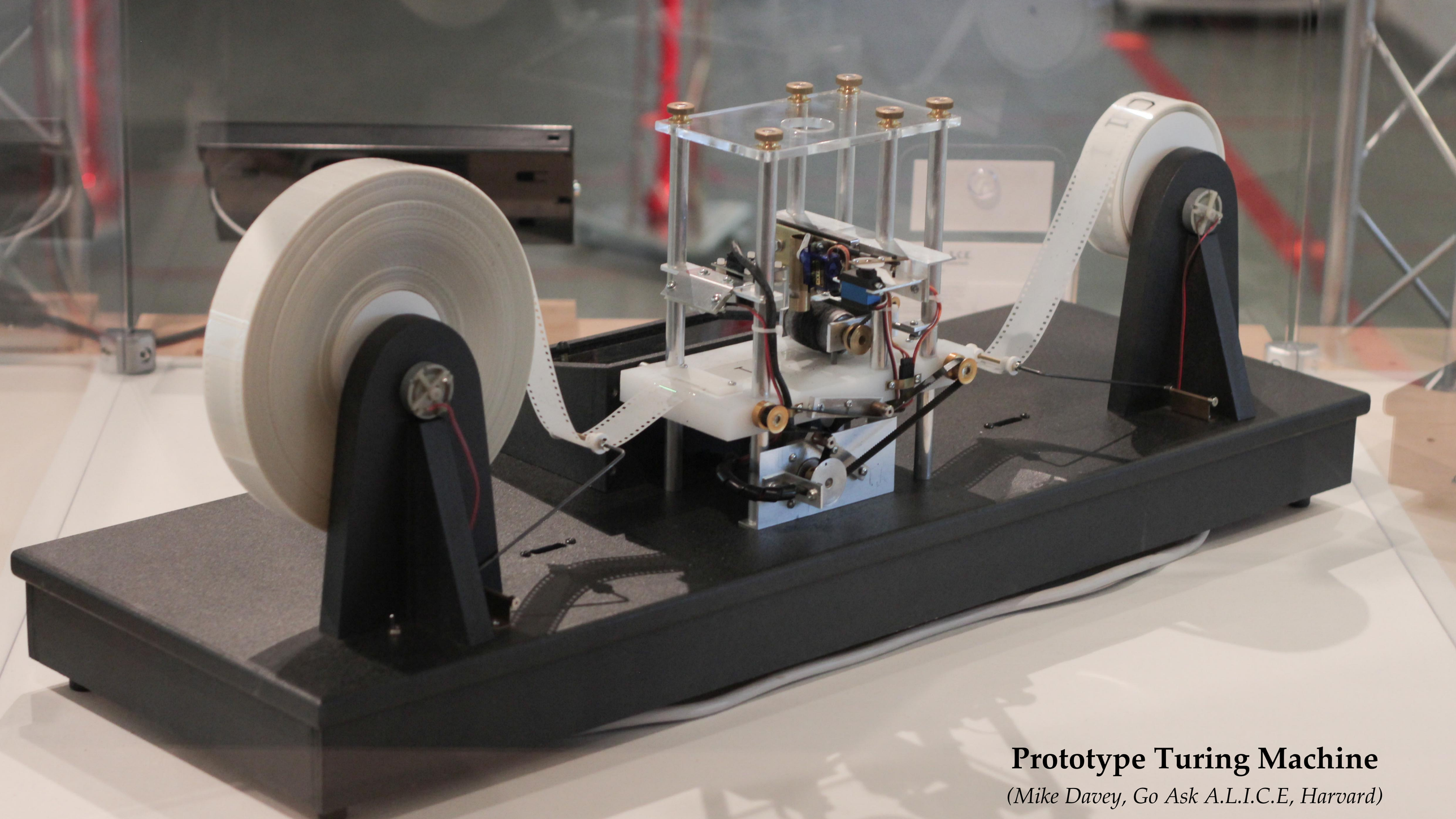


Charles Babbage’s Difference Engine, 1822



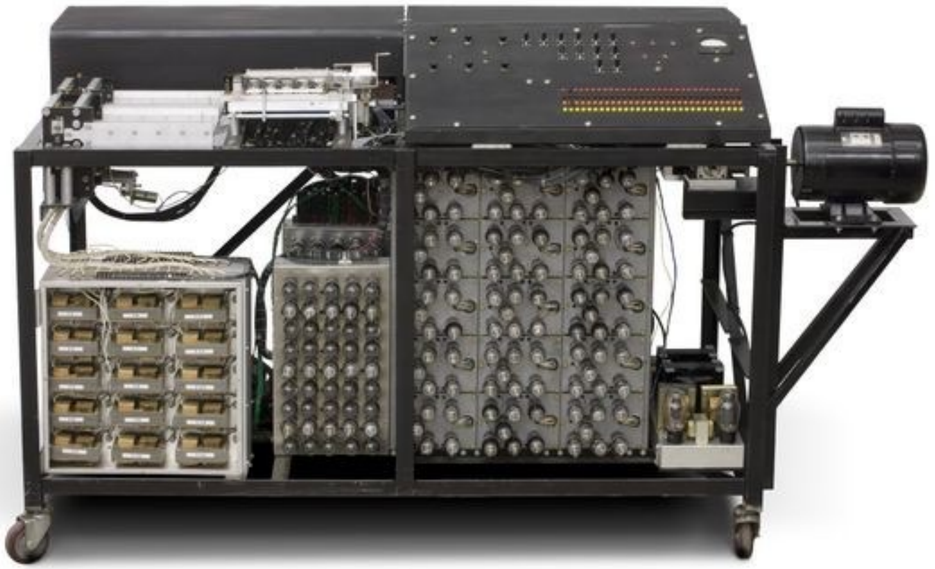
Ada (Byron) Lovelace



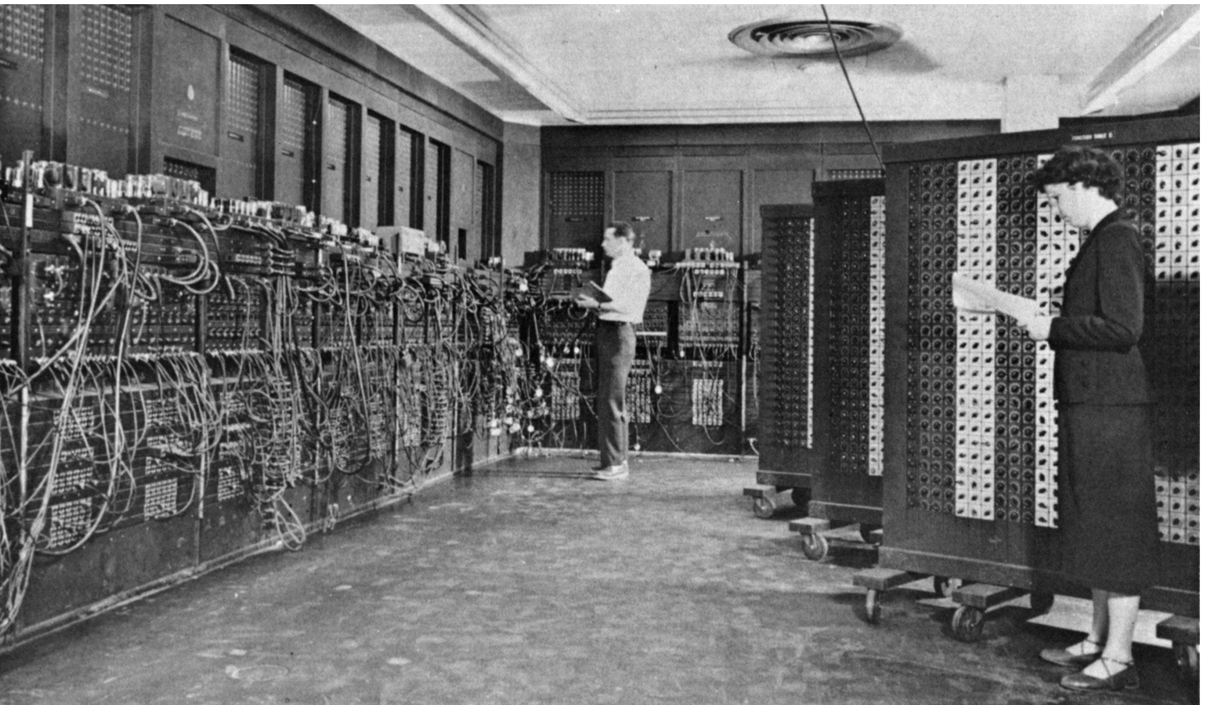


Prototype Turing Machine

(Mike Davey, Go Ask A.L.I.C.E, Harvard)



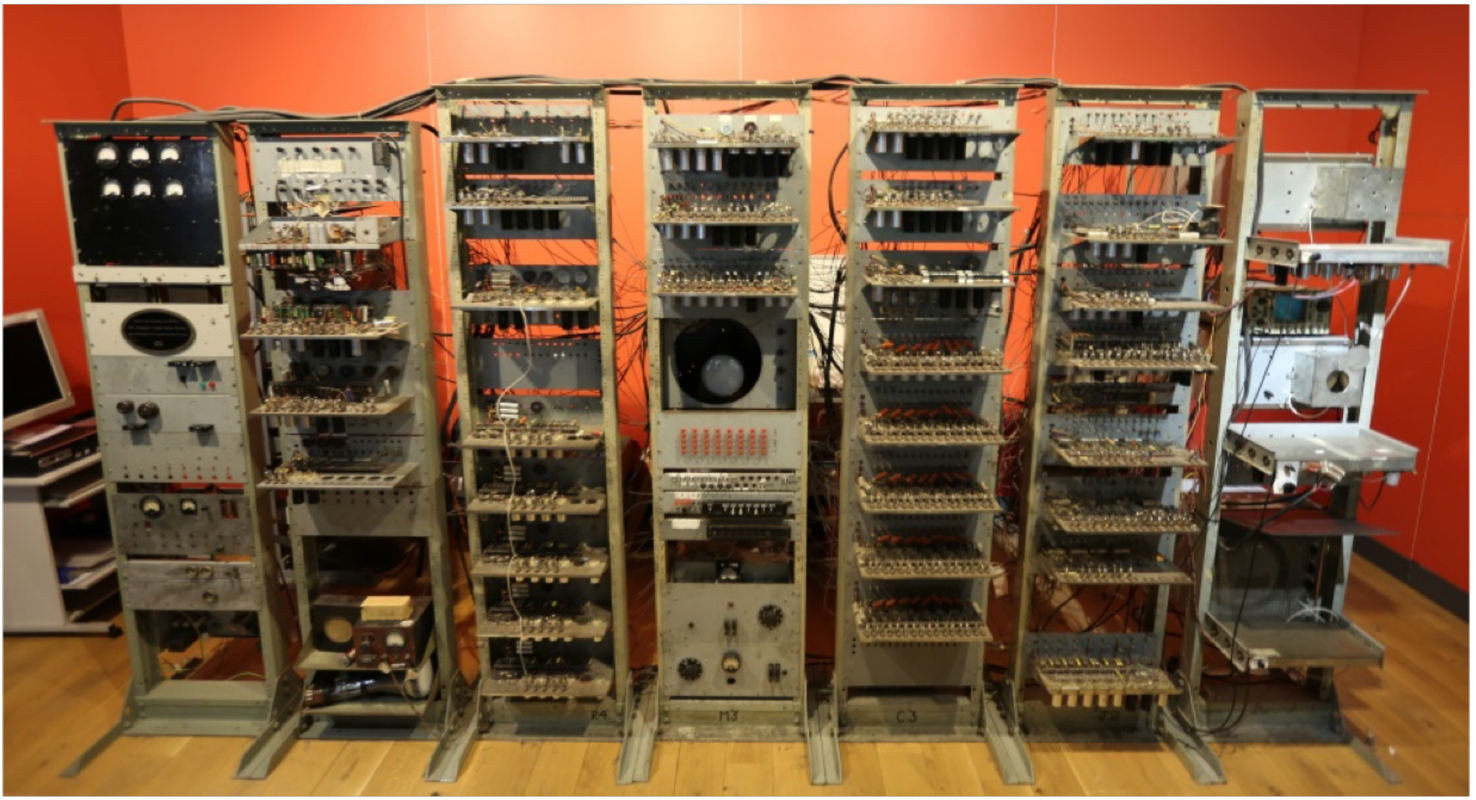
Atanasoff-Berry-Computer, 1939



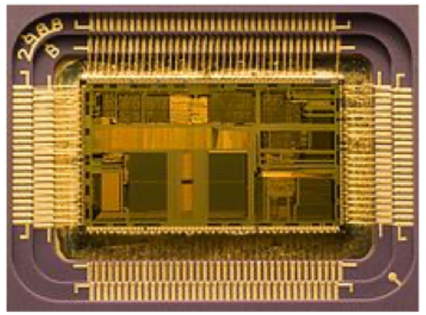
First programmable, electronic,
general-purpose digital computer

ENIAC, 1945

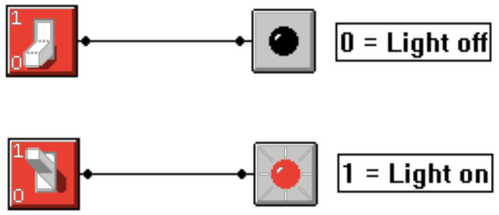
Add-subtract module



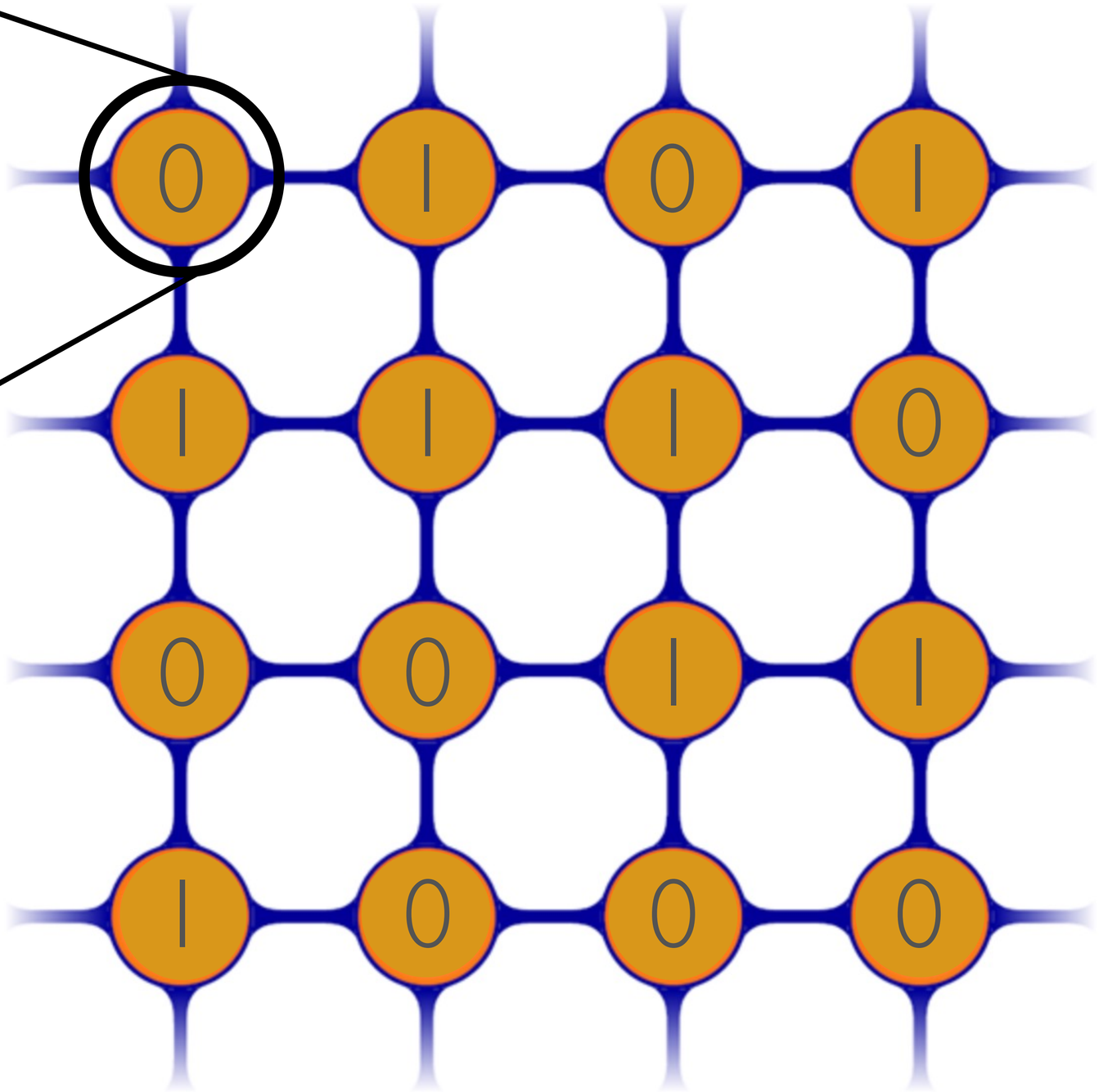
“Moore’s Law”

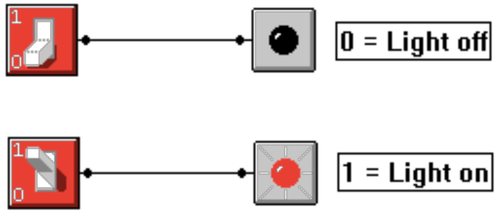


20 billion transistors!

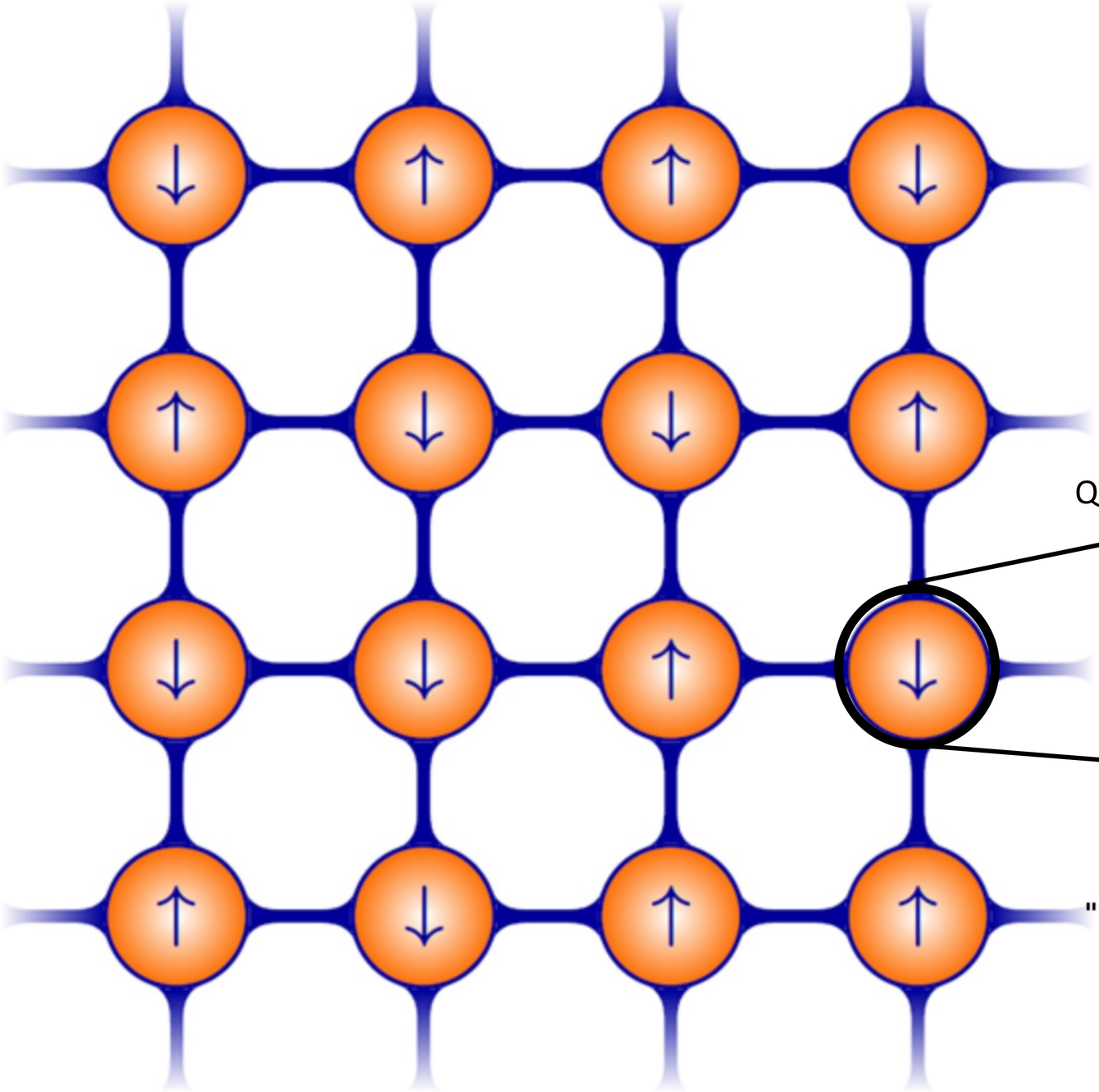


Digital Bit

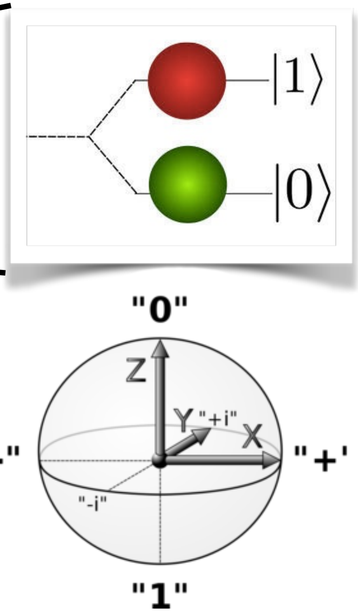




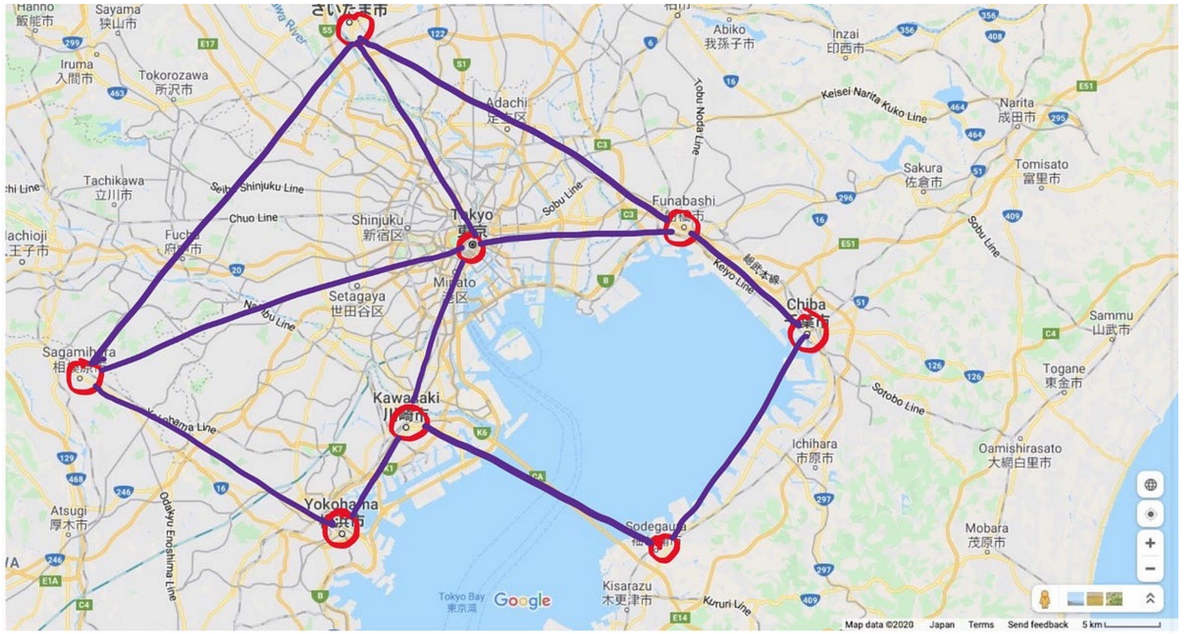
Digital Bit

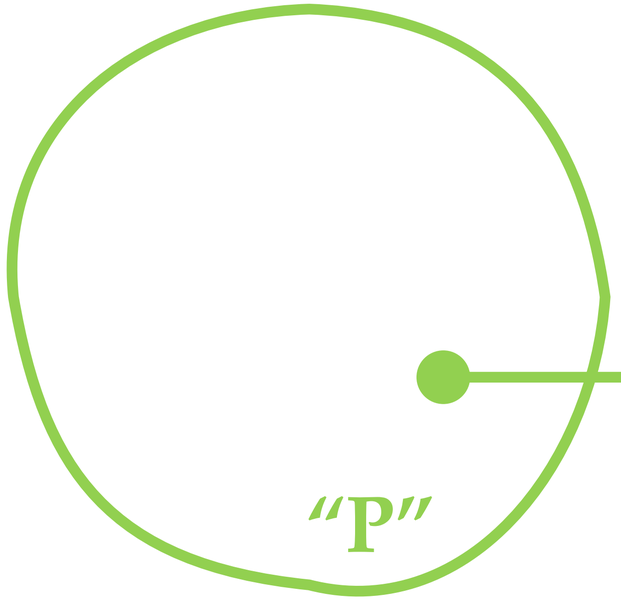


Quantum Bit: “Qubit”

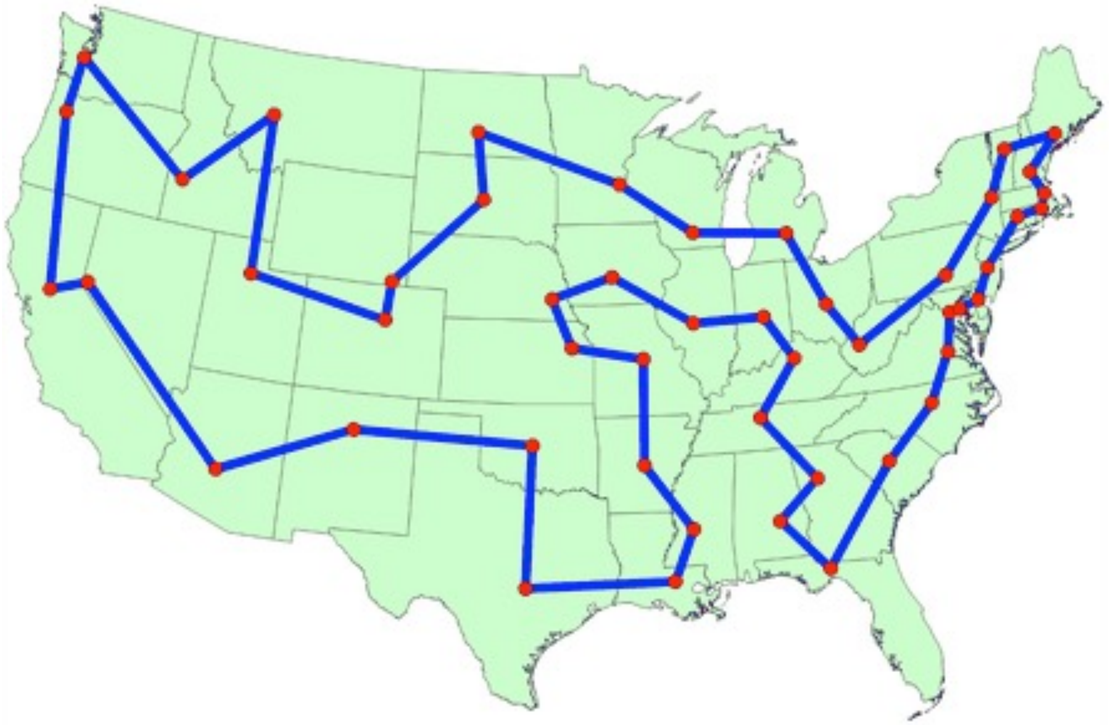


Big question: Why?





Shortest Path problem

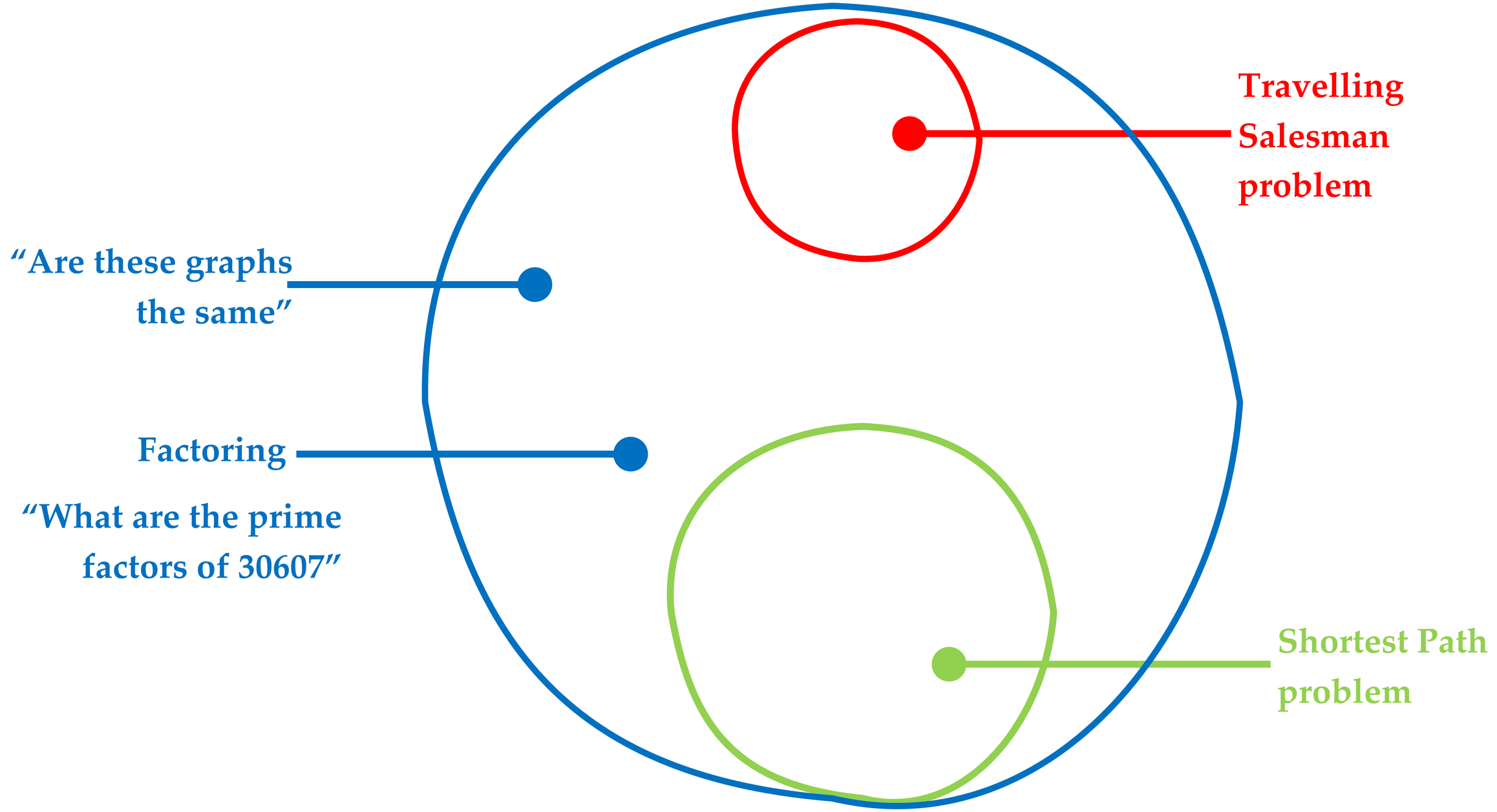


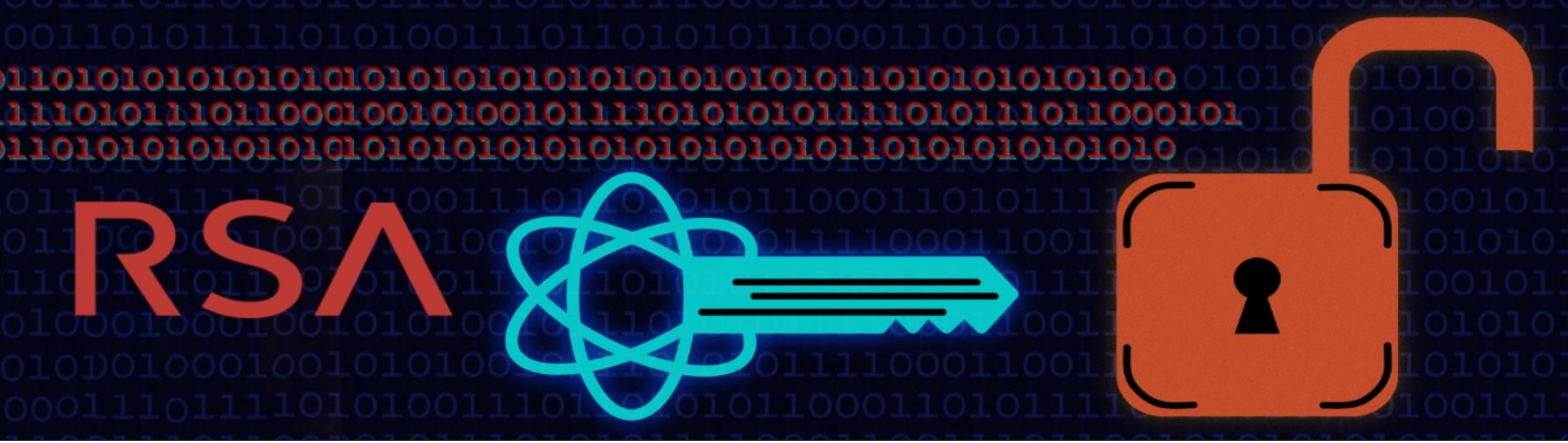
“NP Complete”

Travelling Salesman problem

“P”

Shortest Path problem

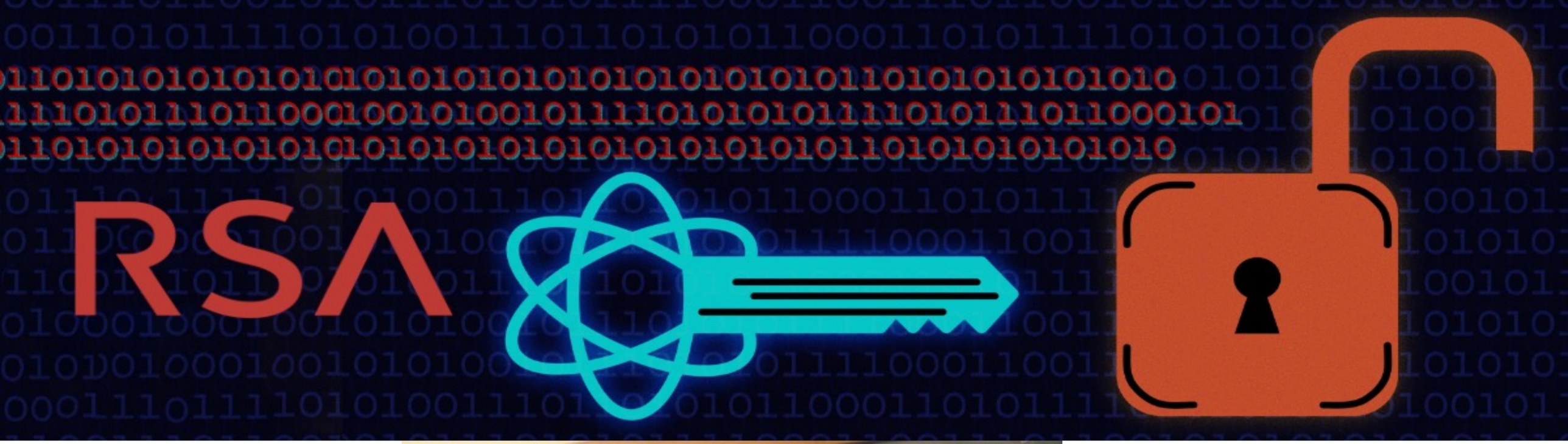

Travelling Salesman problem
"Are these graphs the same"
Factoring
"What are the prime factors of 30607"
Shortest Path problem



Basis of modern cryptography

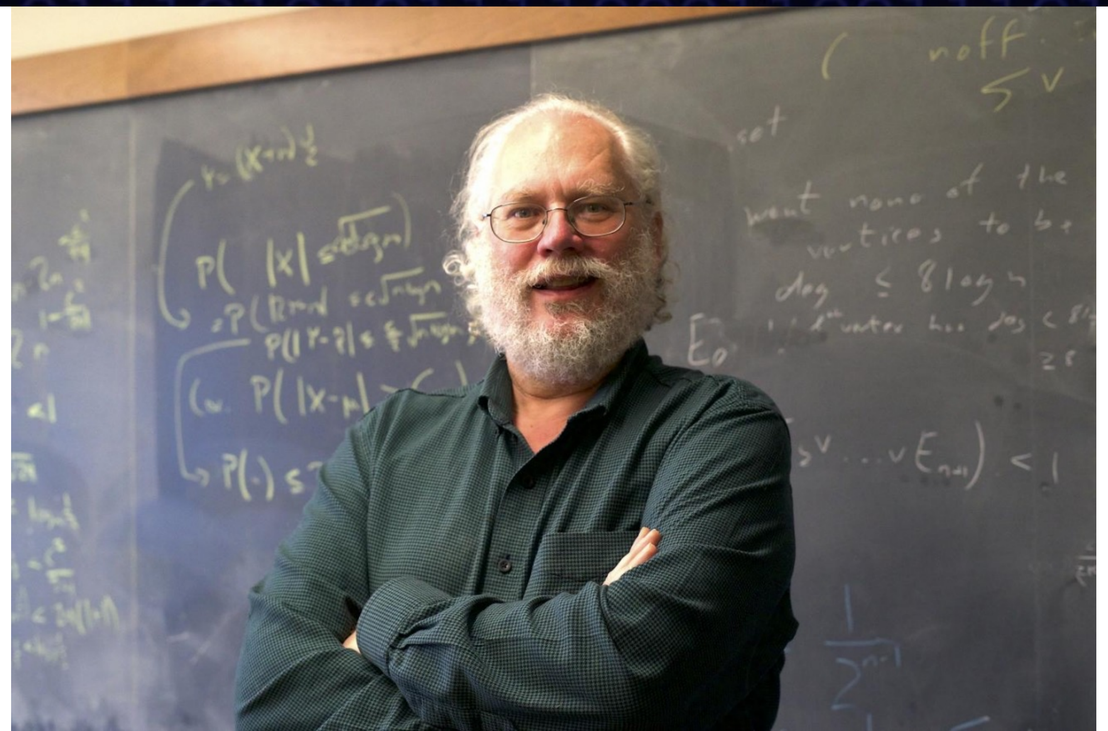
Factoring

“What are the prime factors of 30607”



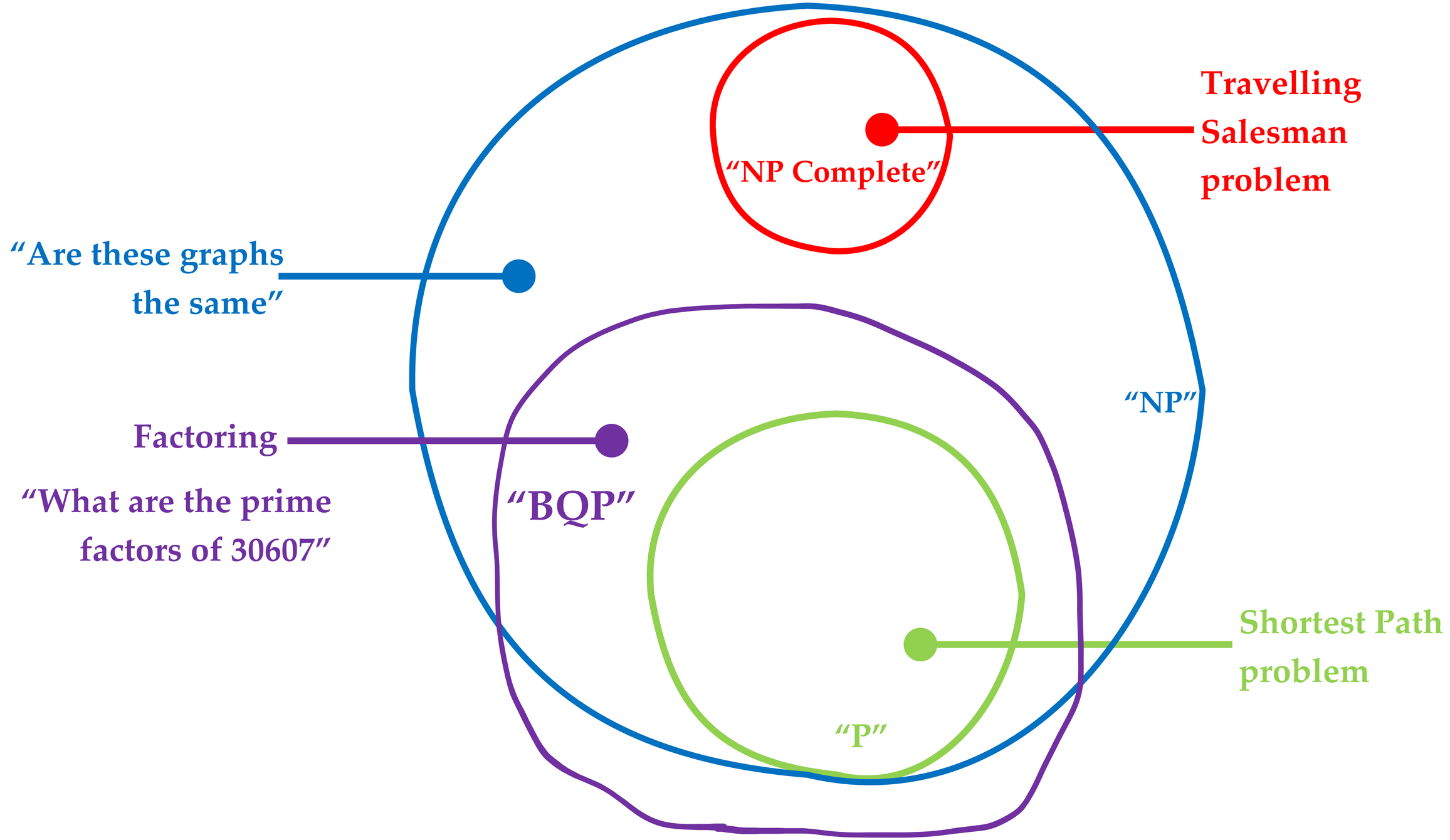
Factoring

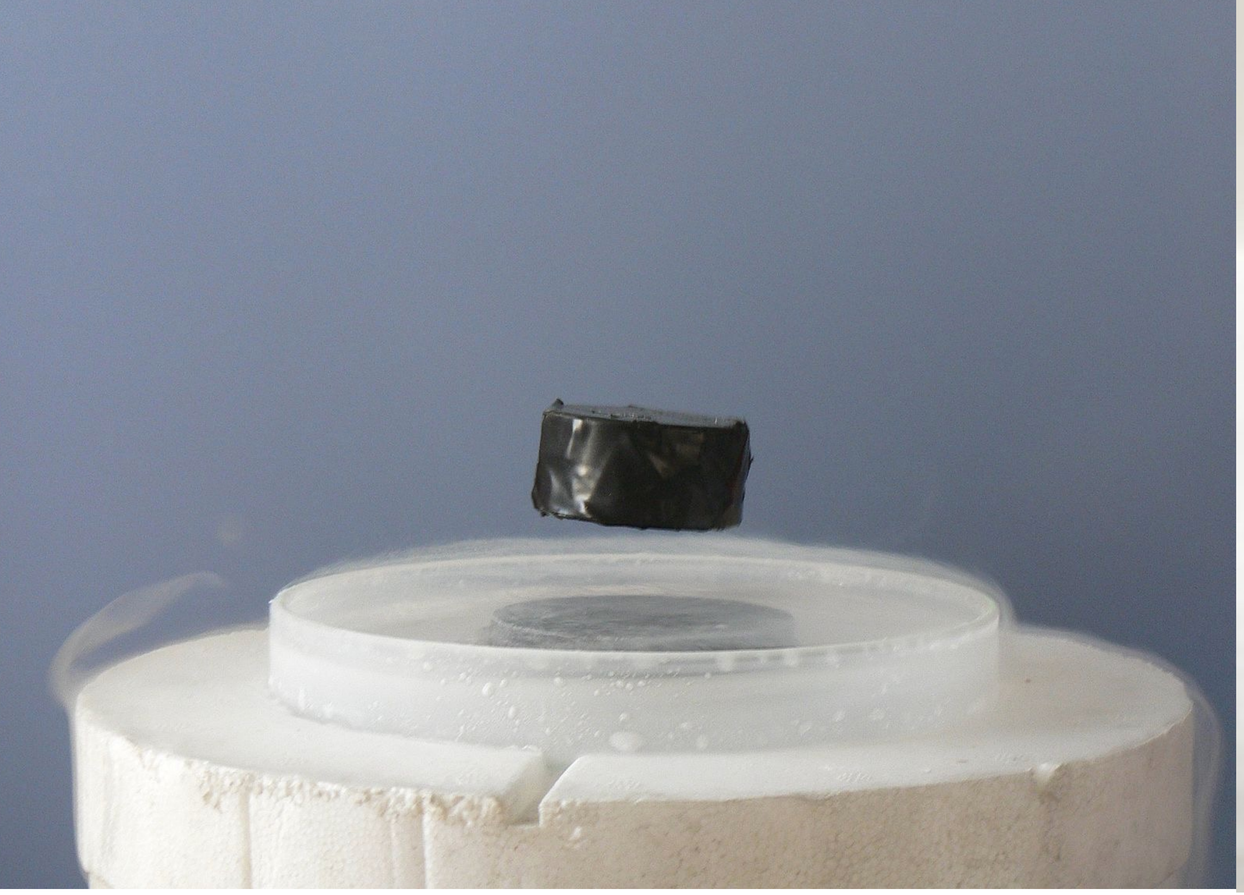
“What are the prime factors of 30607”

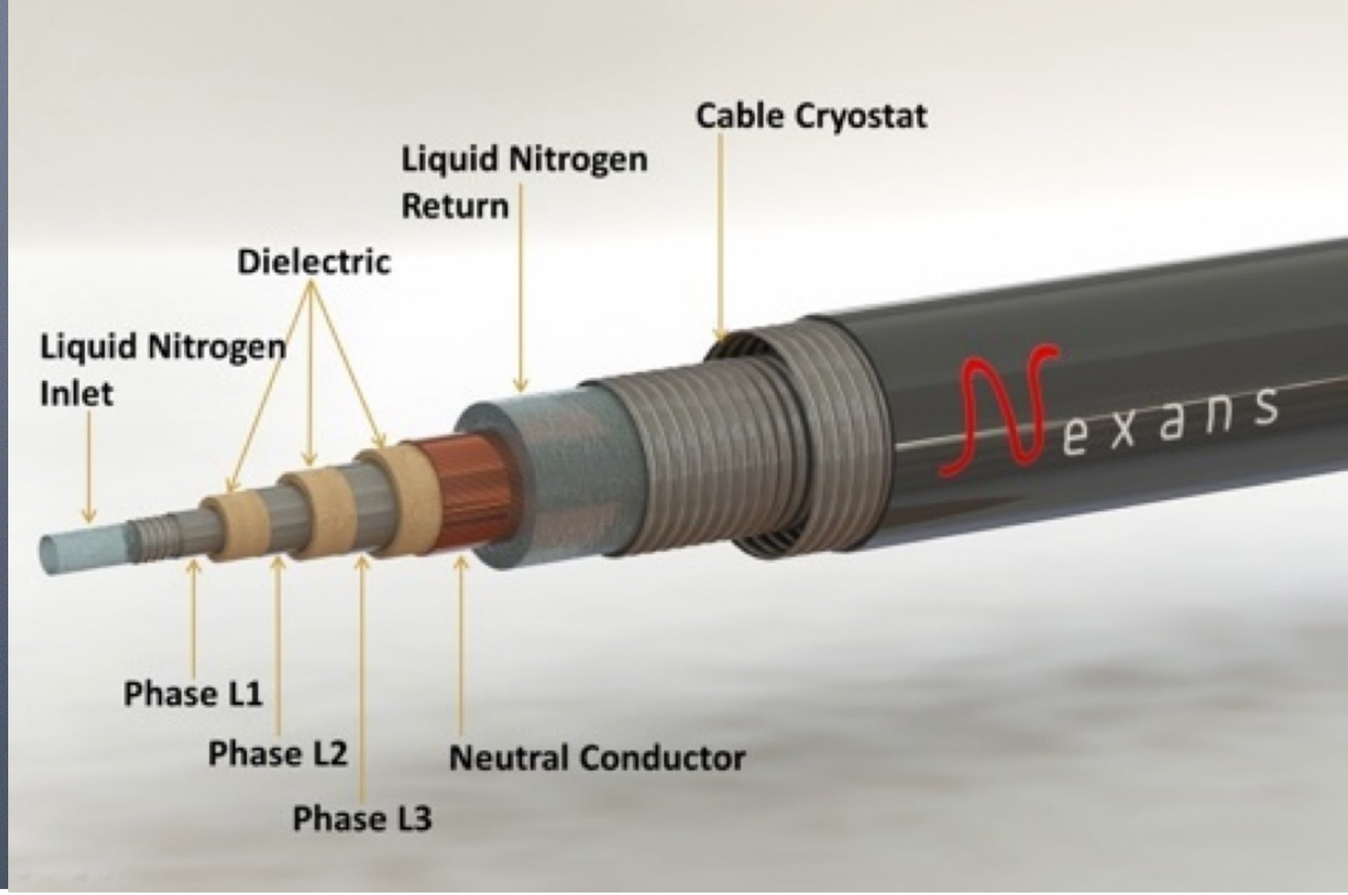


Shor’s Algorithm, 1994

Quantum Computing!







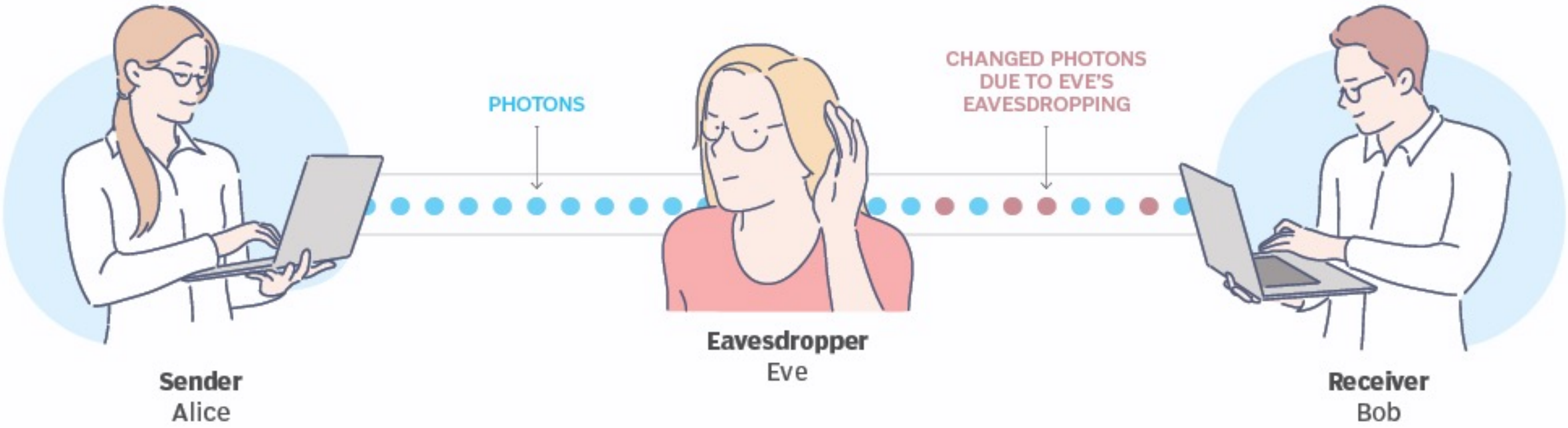
Materials Design.
Superconductors for:

Levitating trains?
Loss-less undersea cables?

This Chemical Reaction Revolutionized Farming. It's Also Destroying the Planet.

Scientists are looking for a cleaner way to grow food.

Quantum cryptography model: The case of Alice, Bob and Eve



A rudimentary quantum network link between Dutch cities

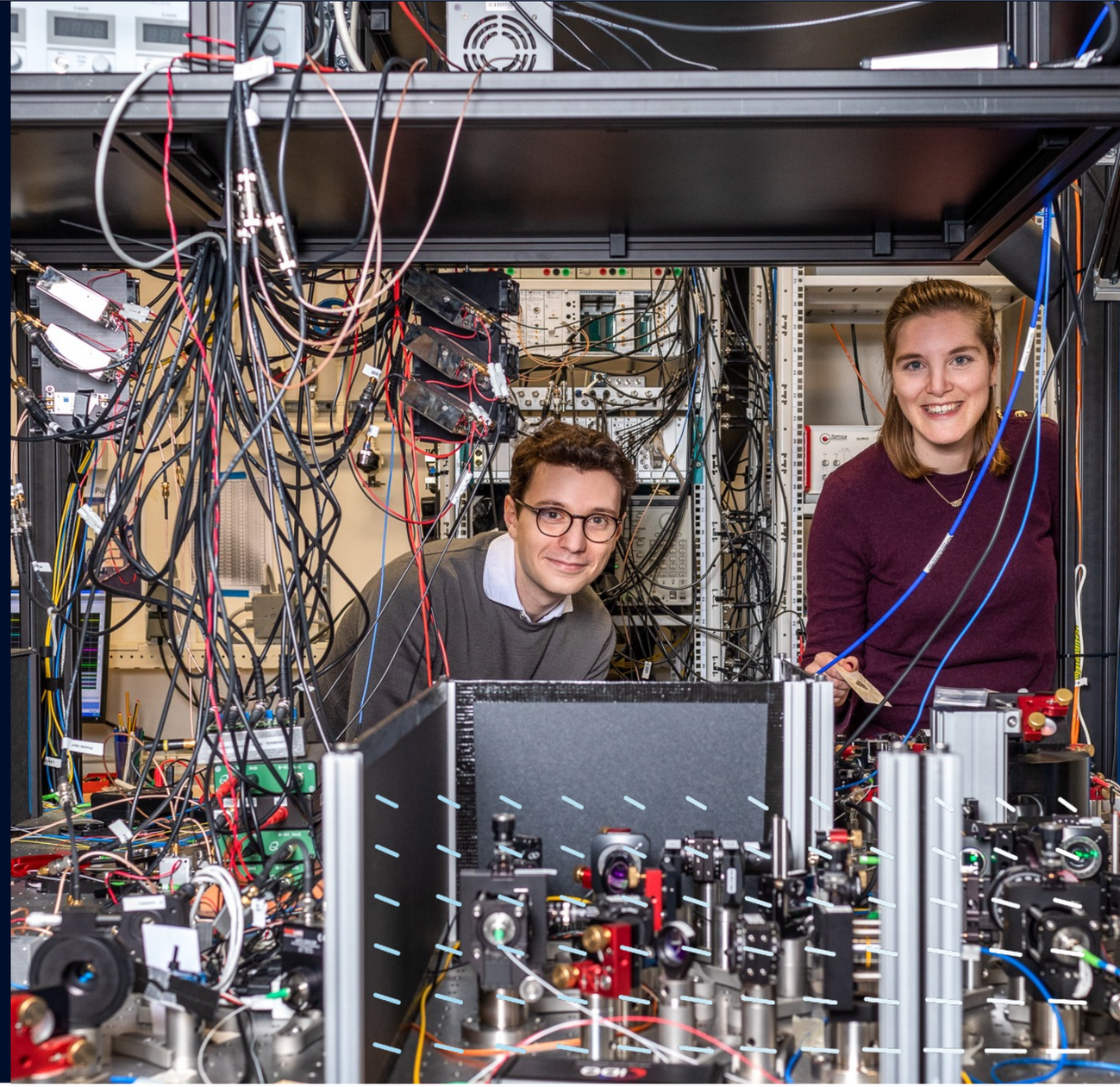
Lab of Ronald Hanson, QuTech

QuTech

Creating the quantum future: From world-class research to world-changing innovation

We perform world-class research leading to scalable prototypes of a quantum computer and a quantum internet, enabling and in close connection with a thriving quantum technology ecosystem

60 fte in 2014, 300 fte today



QuTech

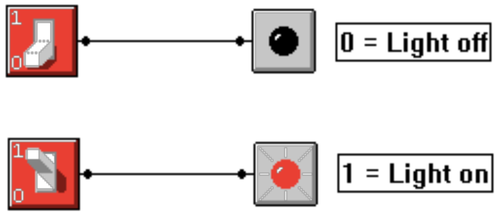
TU Delft
Delft University of Technology

TNO innovation for life

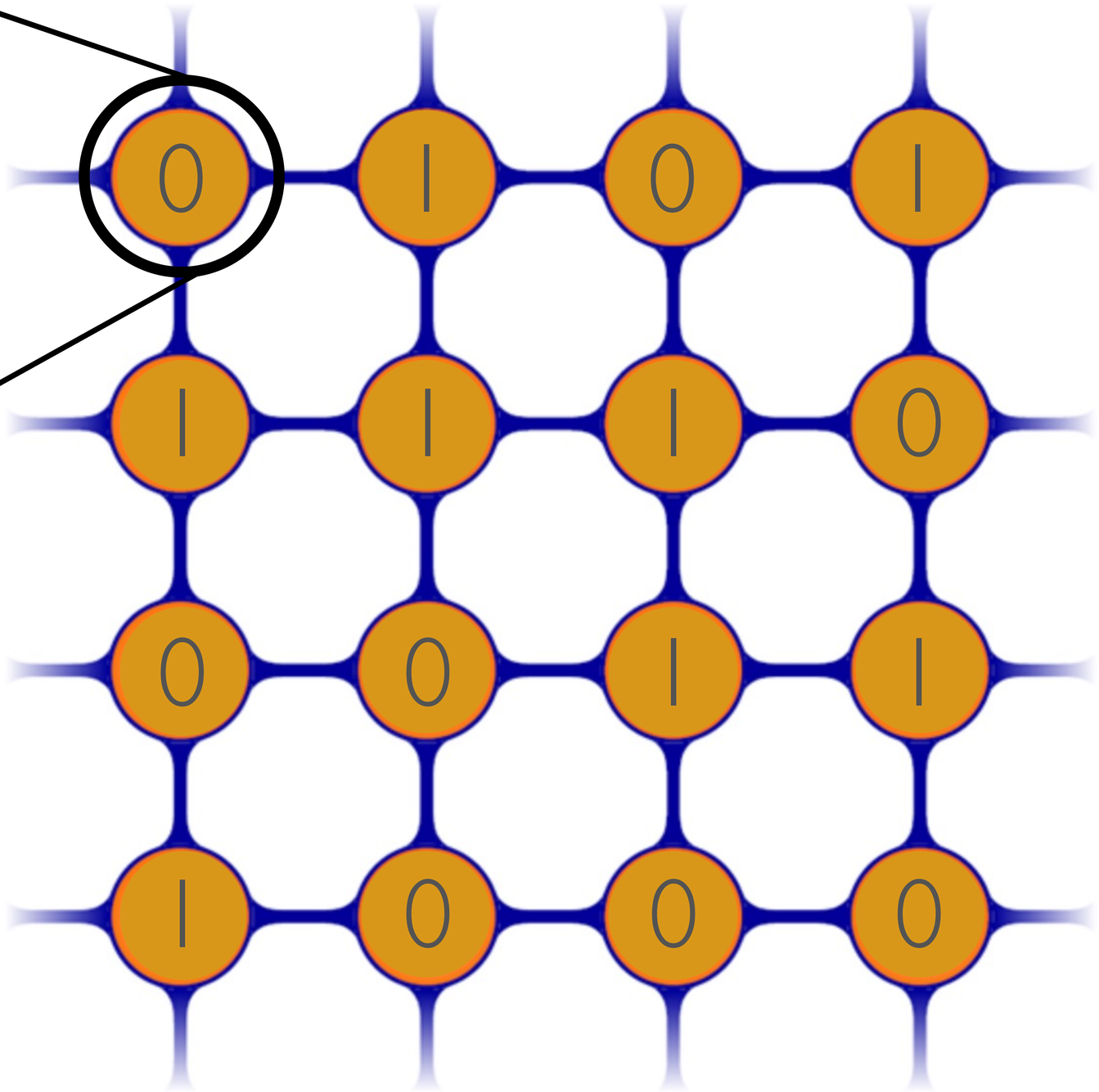
Governments, companies, startups

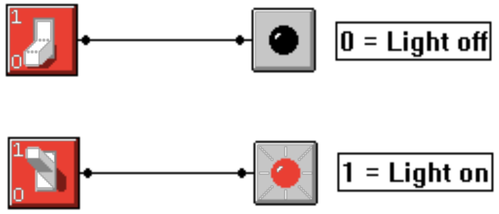
Tech for Impact:

How can we accelerate the quantum revolution?

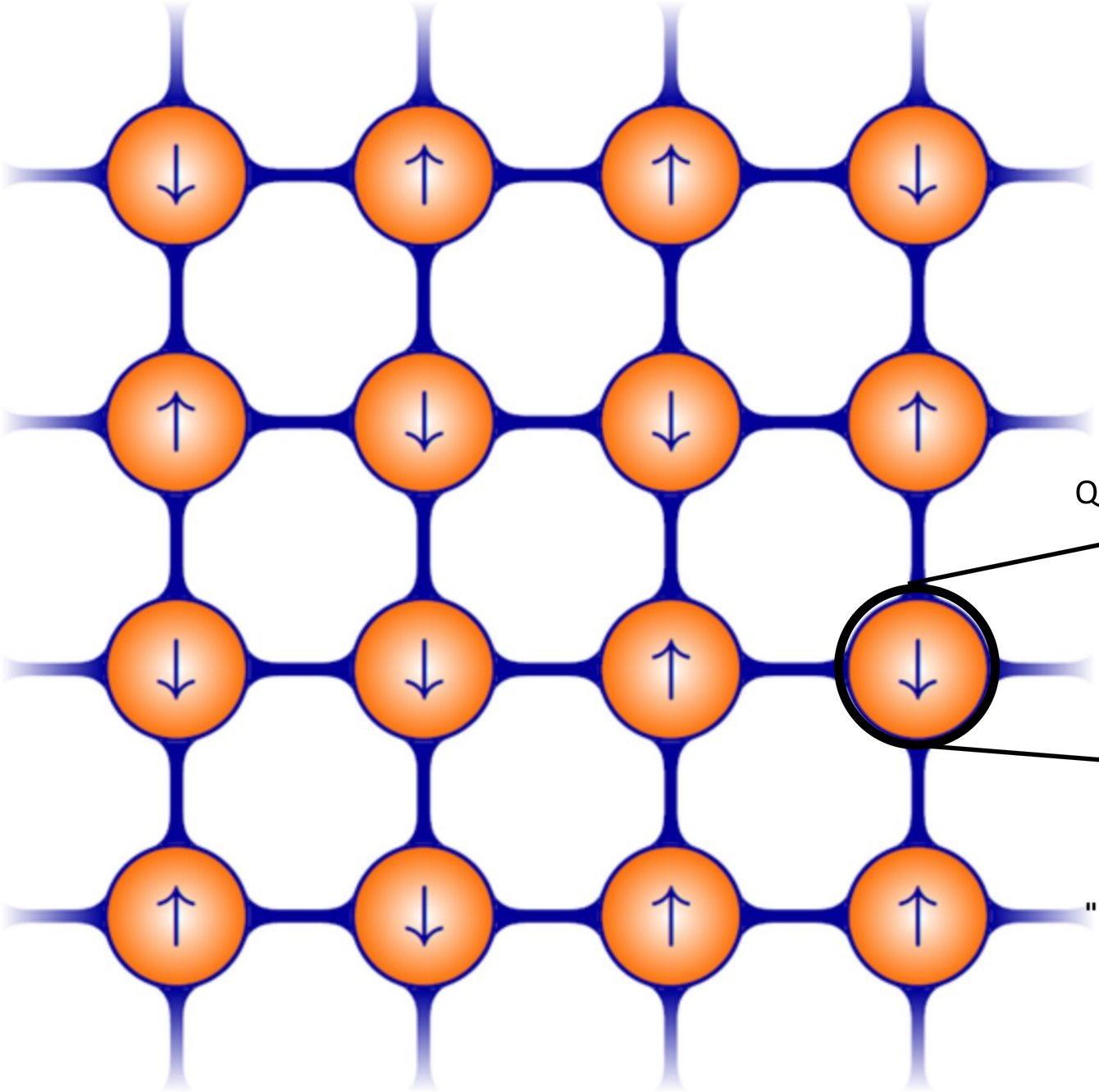


Digital Bit

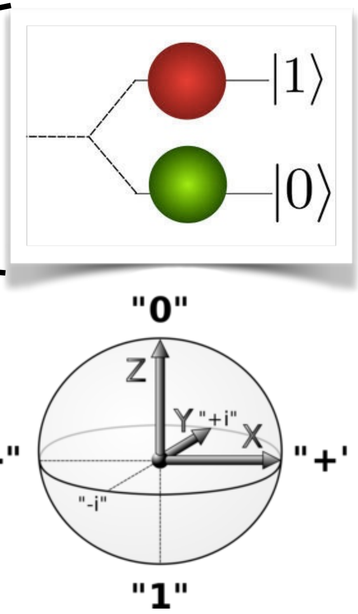


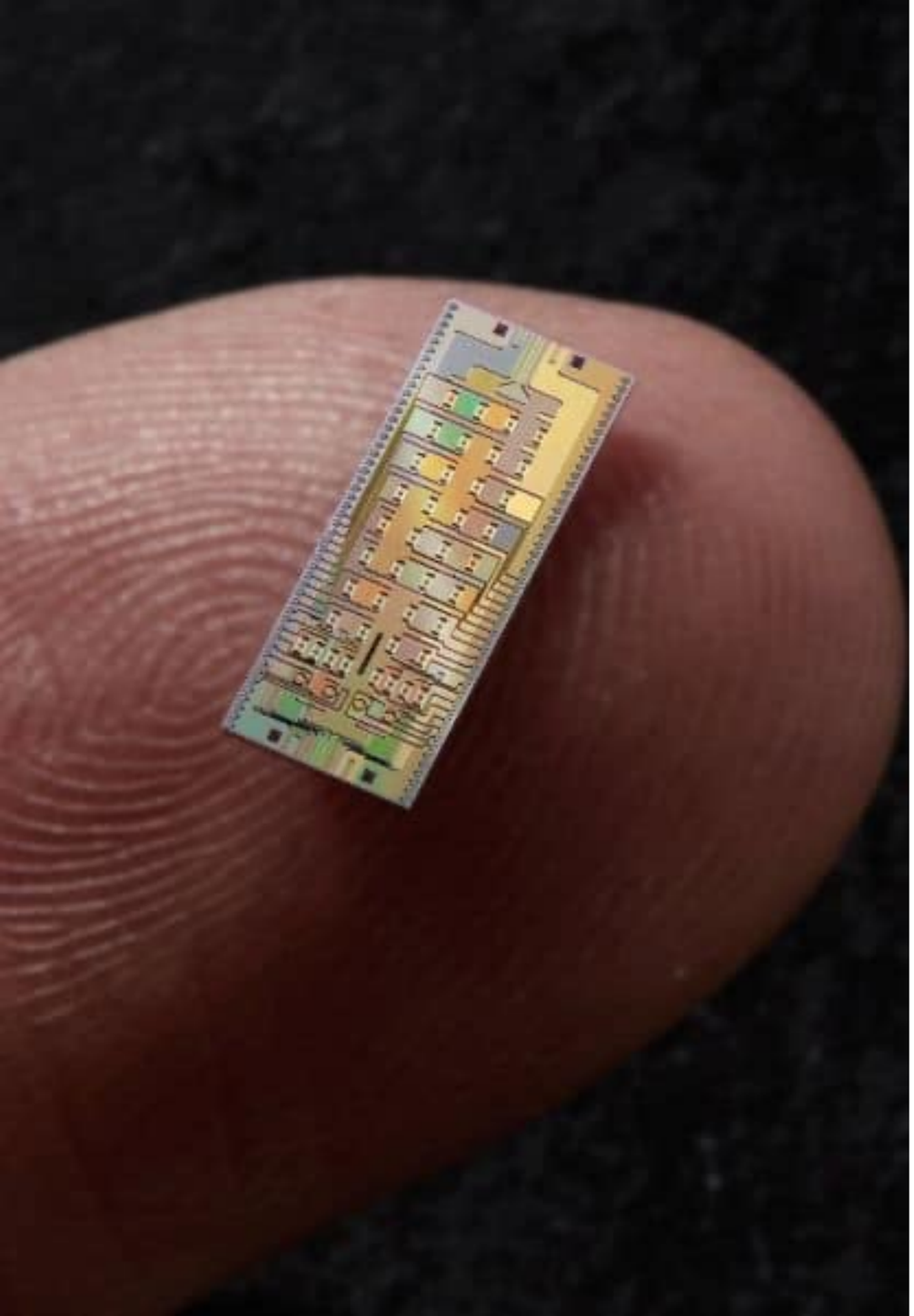


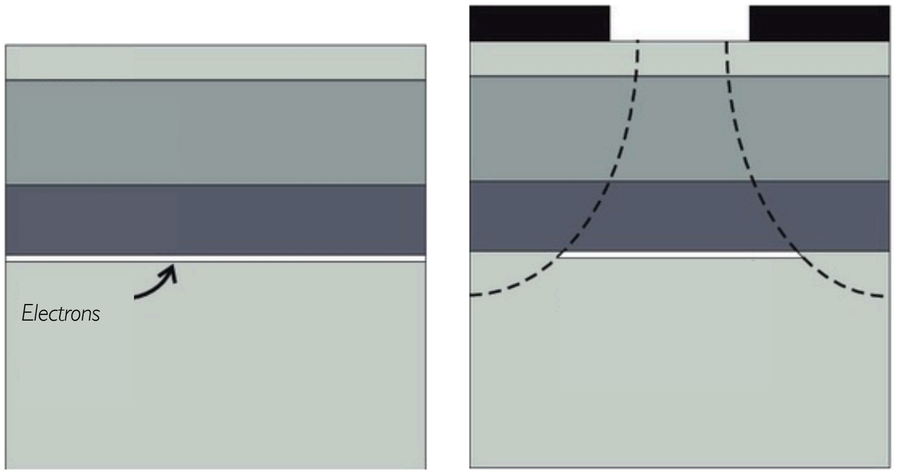
Digital Bit

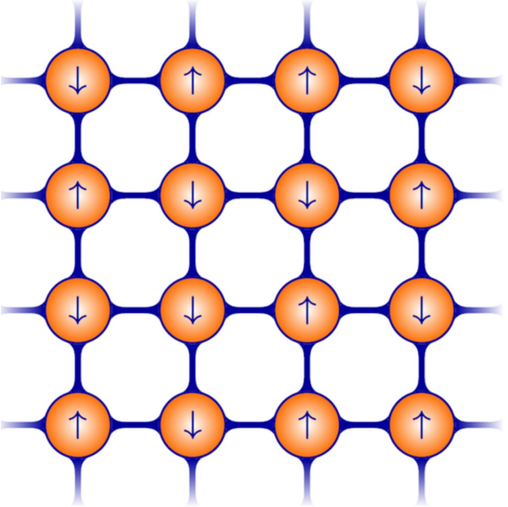


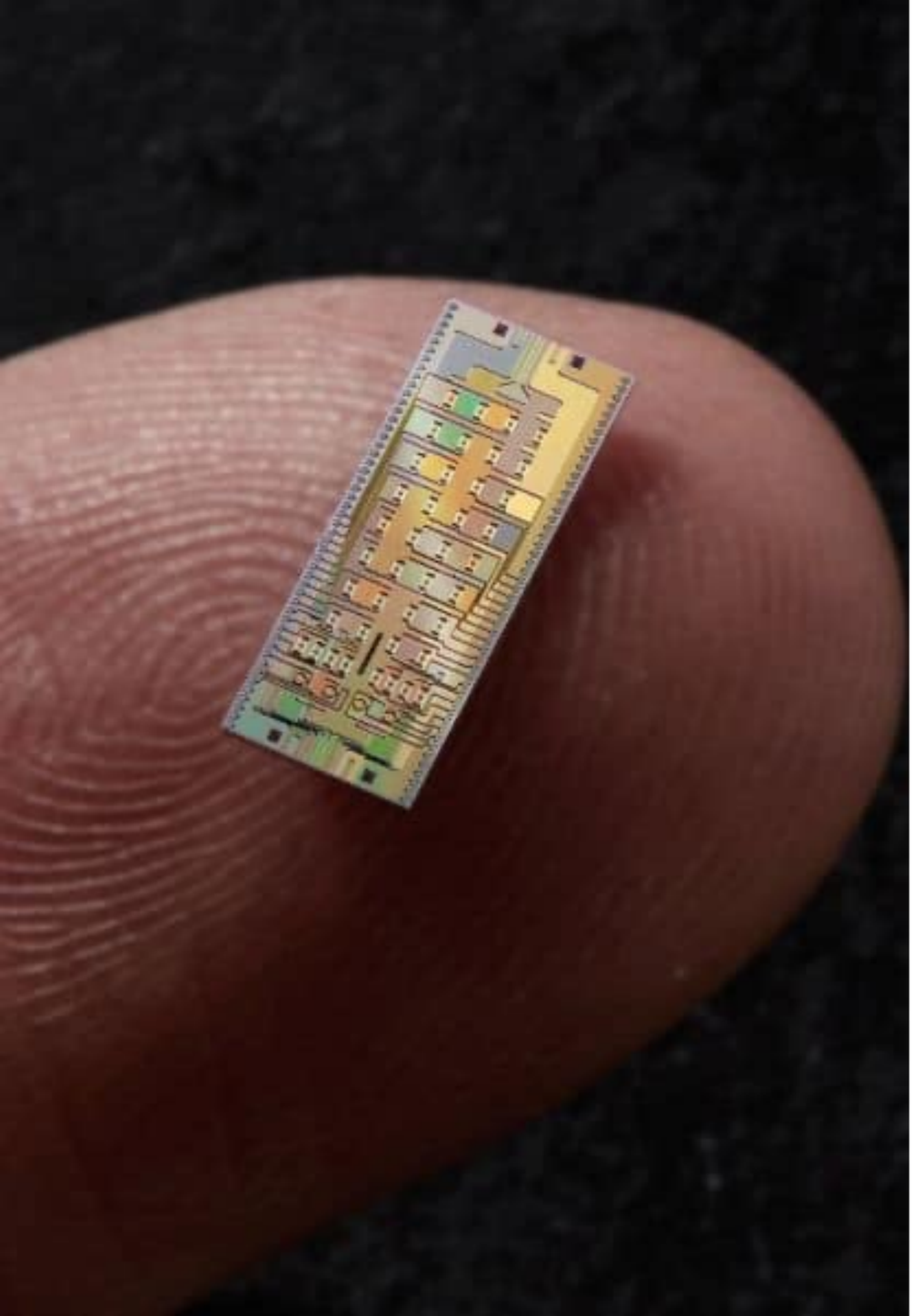
Quantum Bit: “Qubit”

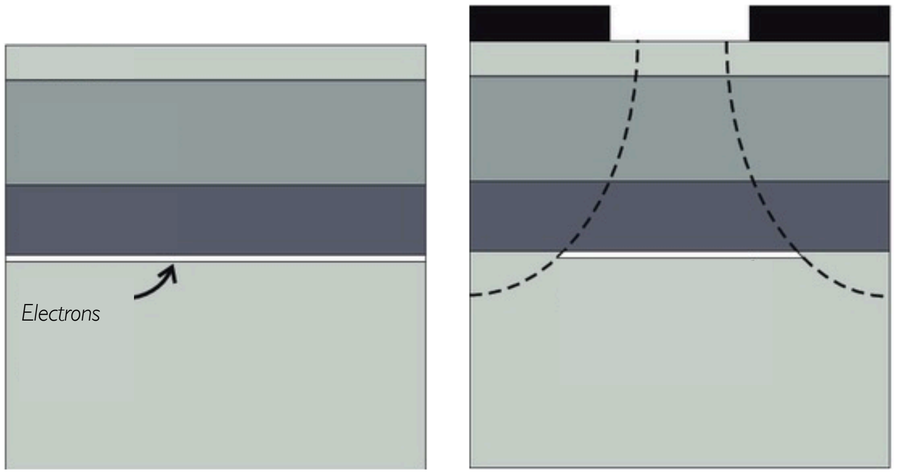


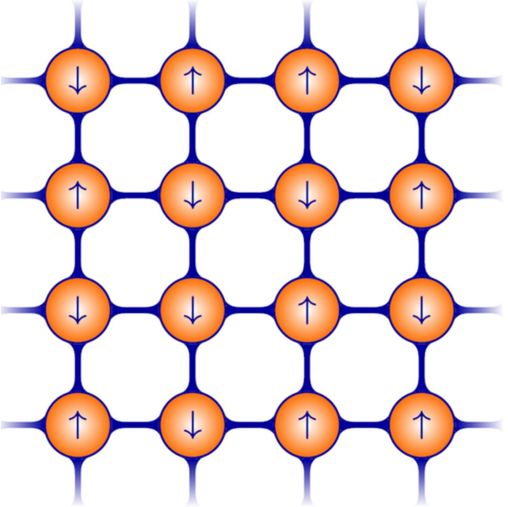


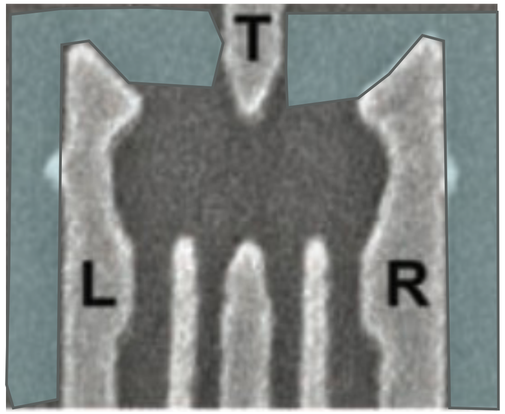

Electrons






Electrons

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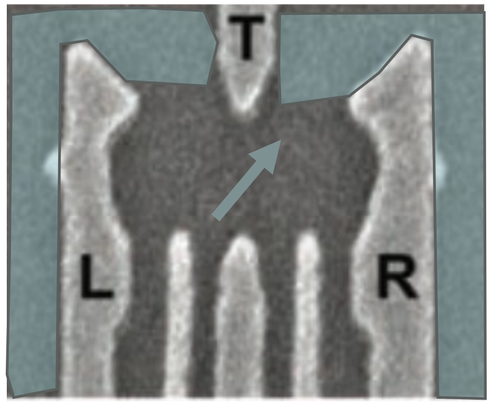
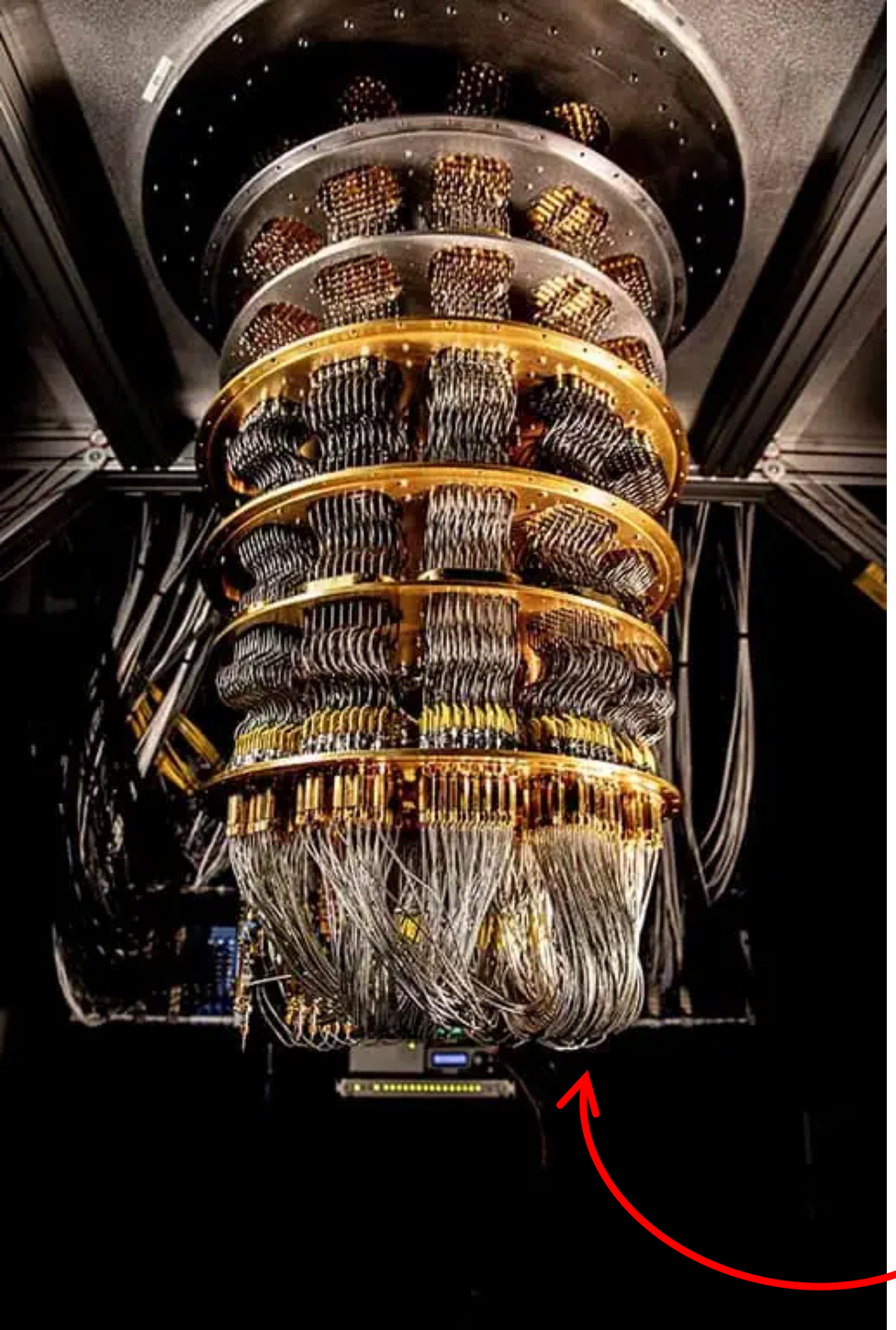
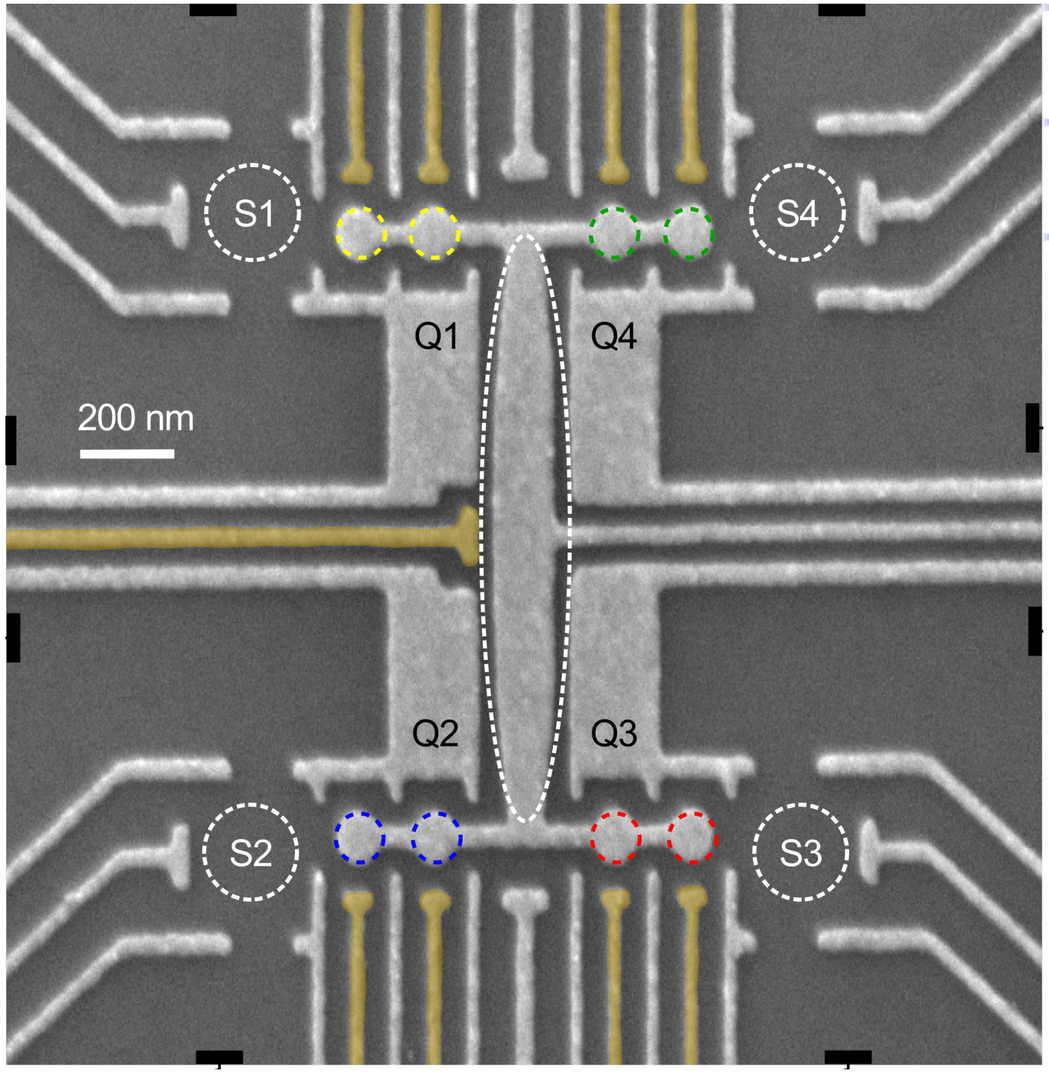
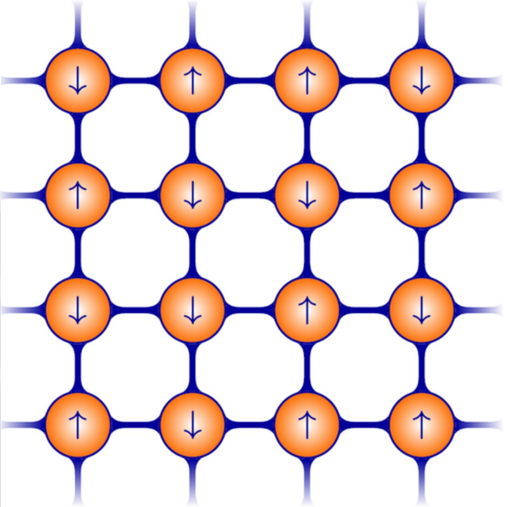

T
L
R

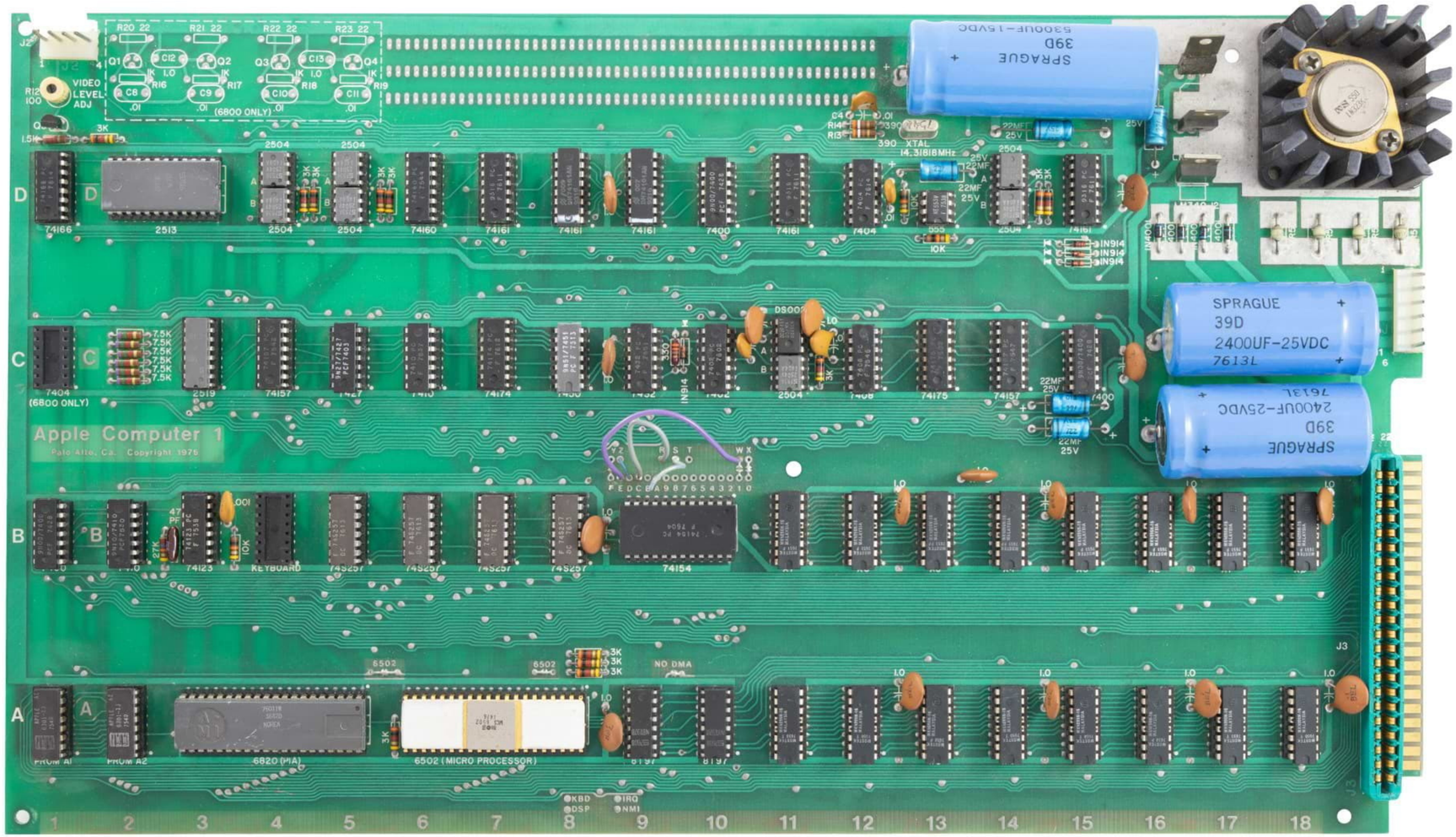






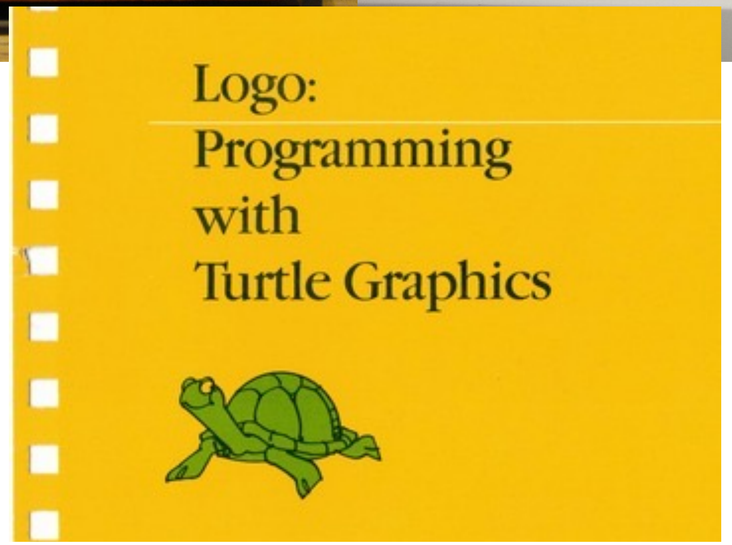
100 times colder than outer space!

APPLE-1



"First unit produced was used in a high school math class"

Apple I computer, 1976




```
READY
>10 PRINT TAB(32);"HAMURABI"
>20 PRINT TAB(15);"CREATIVE COMPUTING  M
ORRISTOWN, NEW JERSEY"
>30 PRINT:PRINT:PRINT
>80 PRINT "TRY YOUR HAND AT GOVERNING AN
CIENT SUMERIA"
>90 PRINT "FOR A TEN-YEAR TERM OF OFFICE
.":PRINT
>95 D1=0: P1=0
>100 Z=0: P=95:S=2800: H=3000: E=H-S
>110 Y=3: A=H/Y: I=5: Q=1
>210 D=0
>215 PRINT:PRINT:PRINT "HAMURABI:  I BEG
 TO REPORT TO YOU,": Z=Z+1
>217 PRINT "IN YEAR";Z;",";D;"PEOPLE STA
RVED,";I;"CAME TO THE CITY,"
>218 P=P+I
>227 IF Q>0 THEN 230
>228 P=INT(P/2)
>229 PRINT "A HORRIBLE PLAGUE STRUCK!  H
ALF THE PEOPLE DIED."
>
```

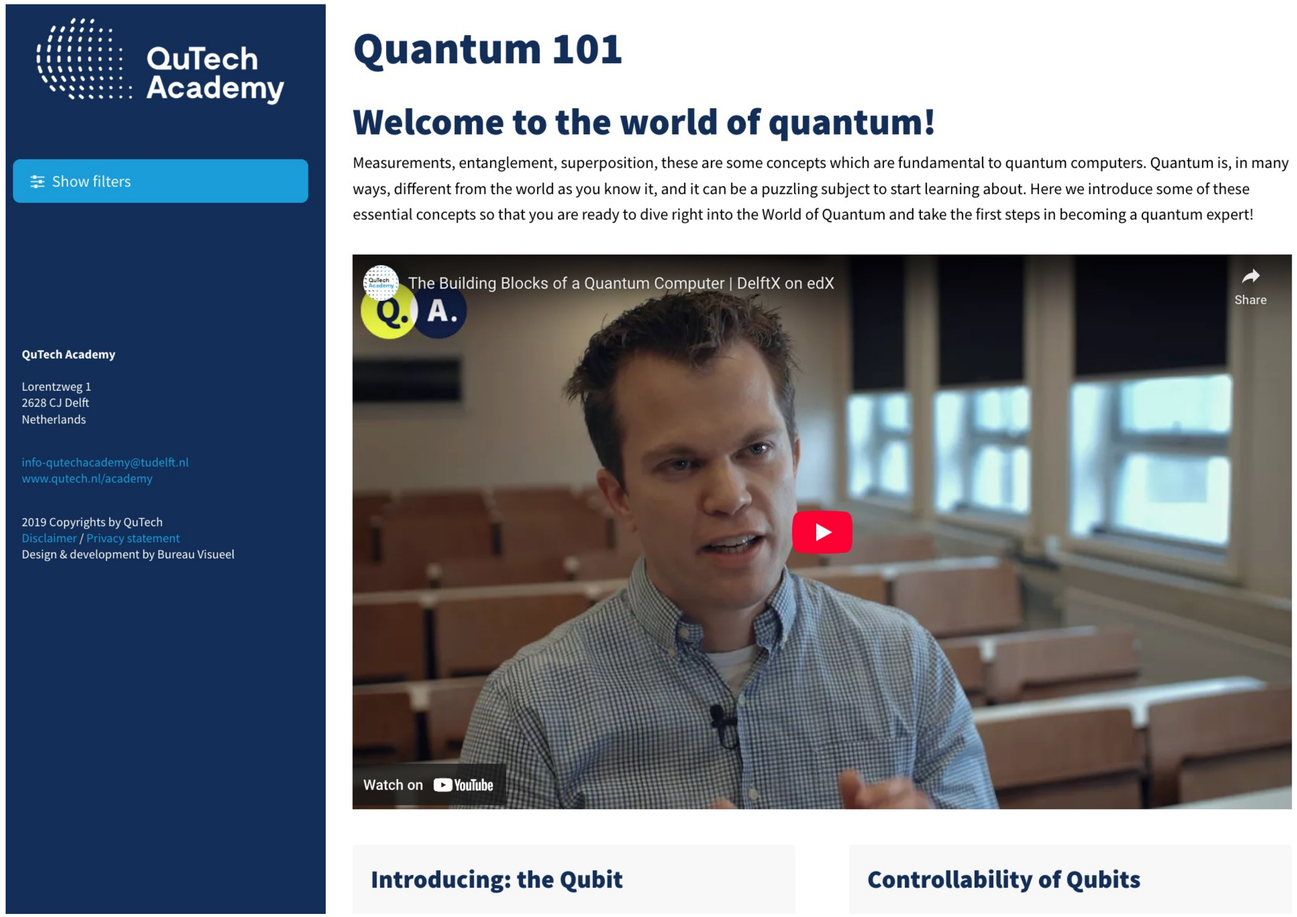
"First unit produced was used in a high school math class"

Apple I computer, 1976

Drexel University, 1983

Get it into the students' hands!

QuTech Academy

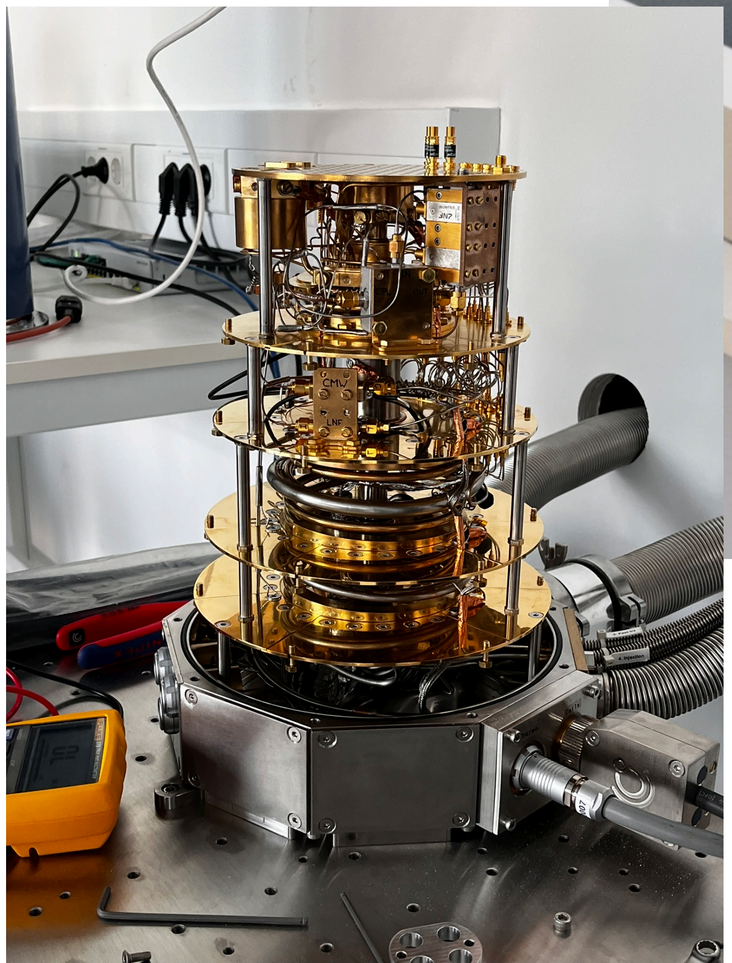


Mission of QuTech Academy

QuTech Academy Lead: Dr. Christian Andersen

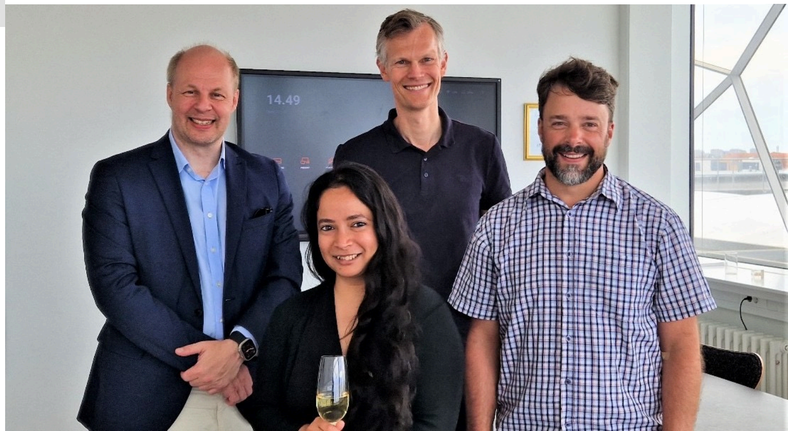
Videos: qutube.nl

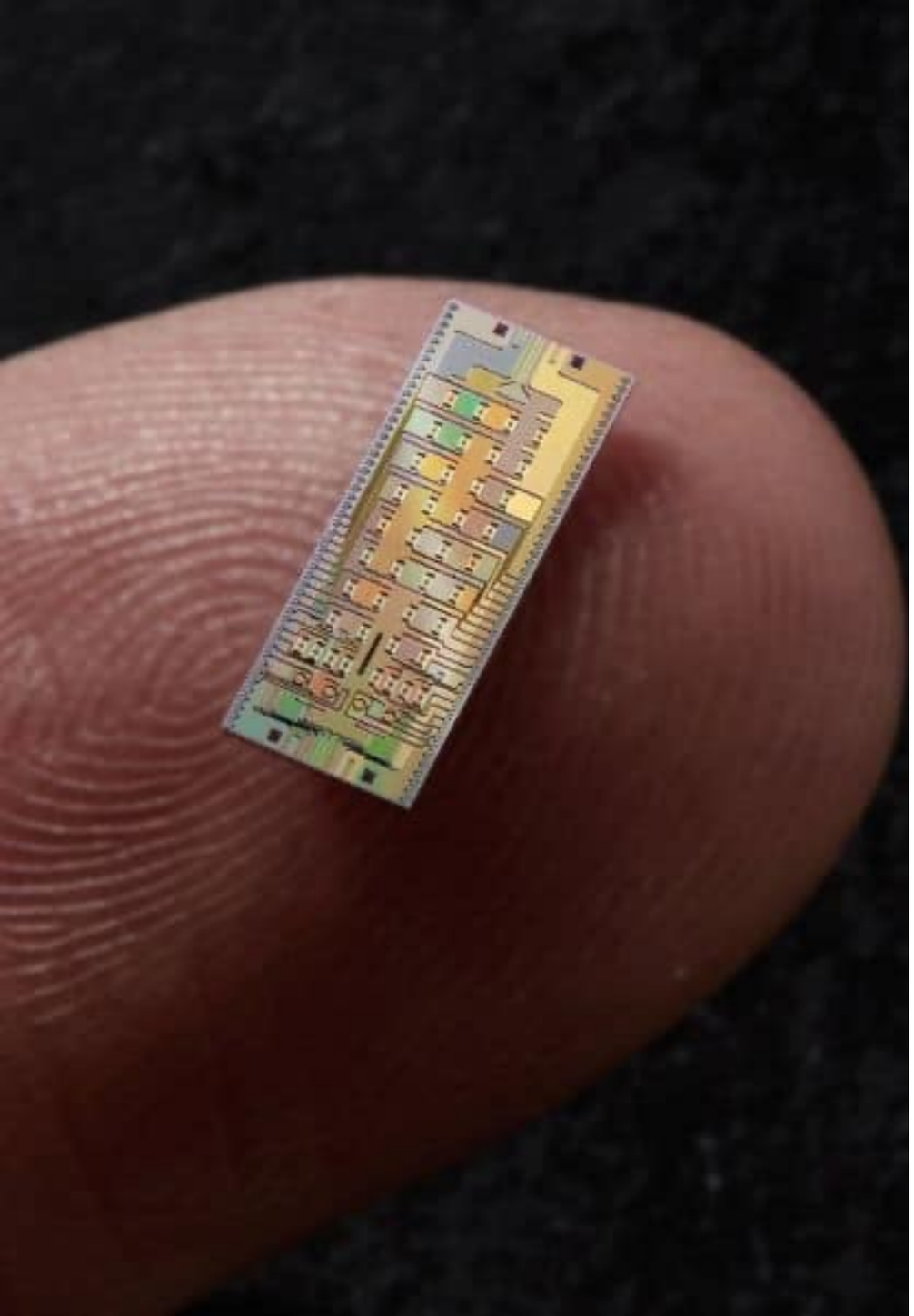
…and others



A.P.Møller Mærsk Quantum Training Laboratory

The University of Copenhagen is Awarded a Quantum Technology Training Laboratory





Tech for Impact:

How can we accelerate the quantum revolution?

By getting quantum chips into the hands of students!