Applications of the course

Lecture 36

Applications of the course

1. Speech synthesis
2. Convolution neural networks
3. Health applications
4. Optics and Spatial filtering
5. And some more

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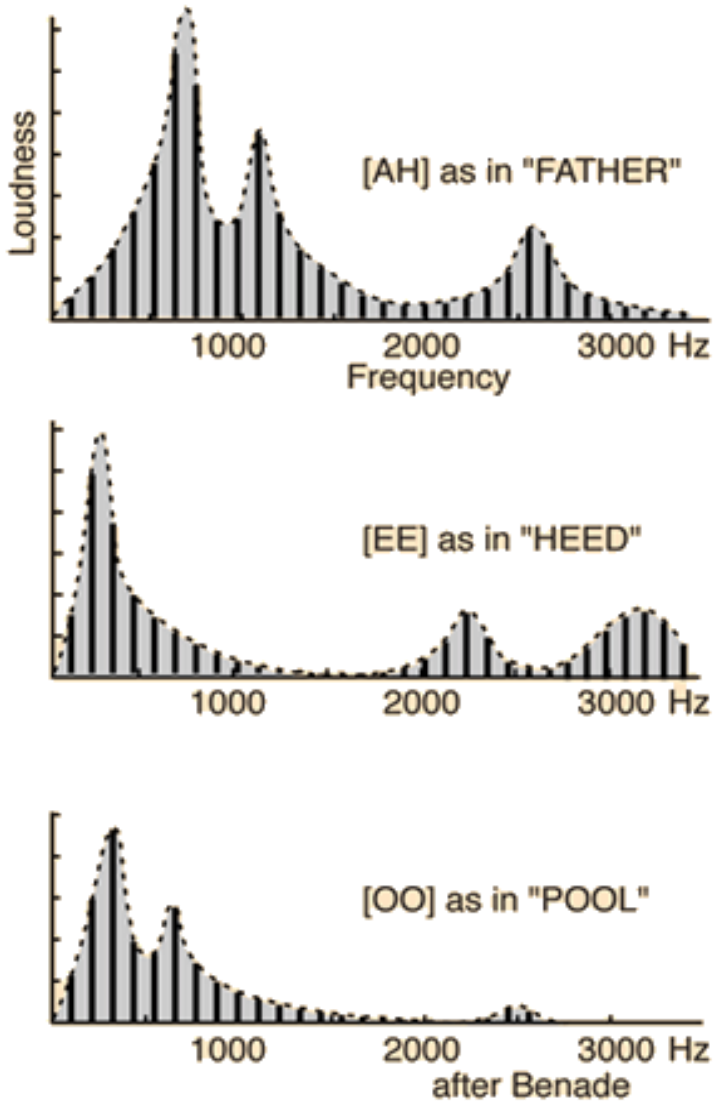
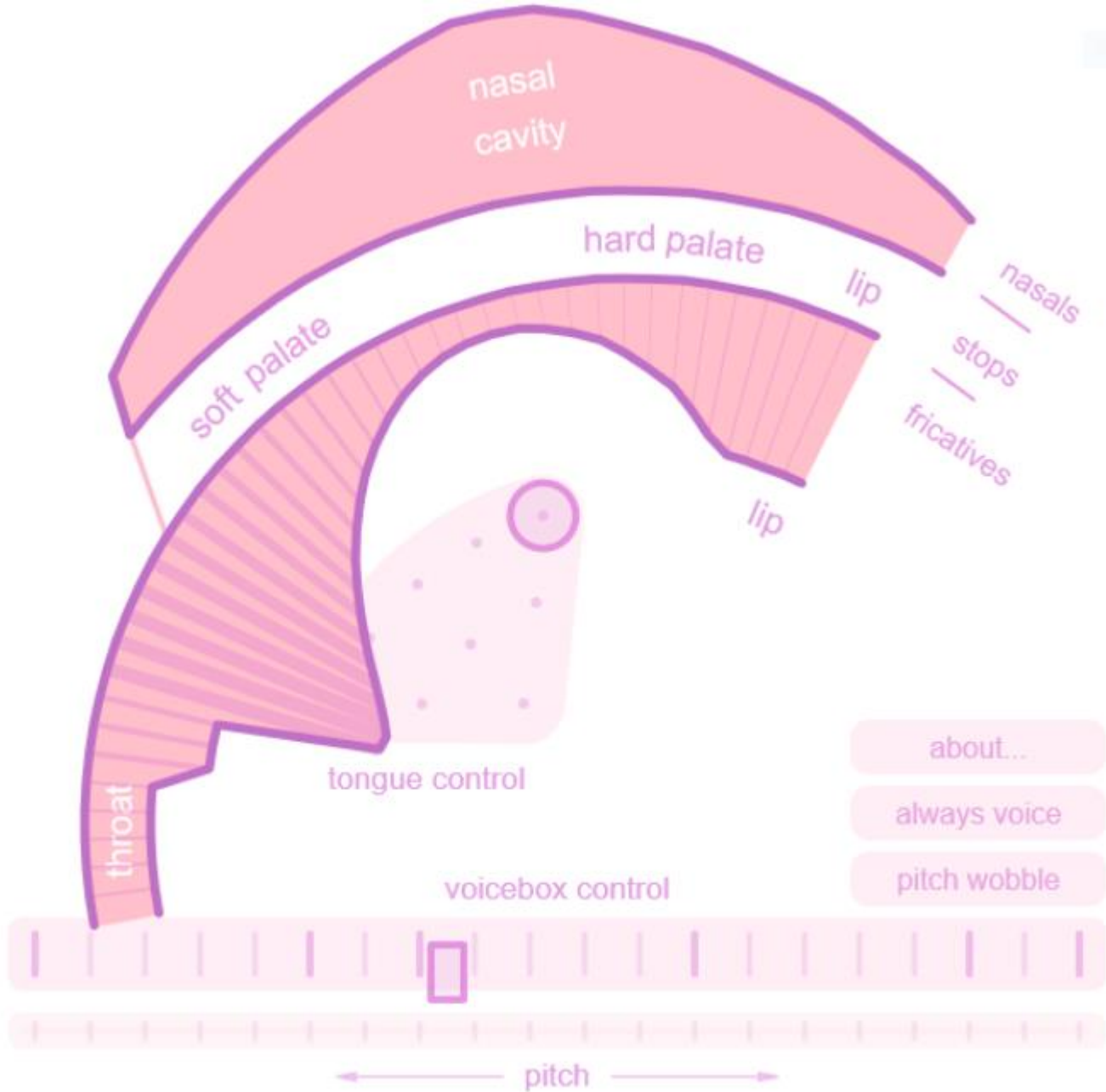
Fourier Series of Vowels



Item	F1	F2	Duration (ms)
heed	292	2352	177
hid	285	2410	126
head	668	1863	179
had	652	1877	132
hud	695	1235	152
hard	818	1182	174
herd	524	1389	169
hawed	568	866	181
hod	460	875	176
whod	289	813	220
hood	296	935	163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soft palate
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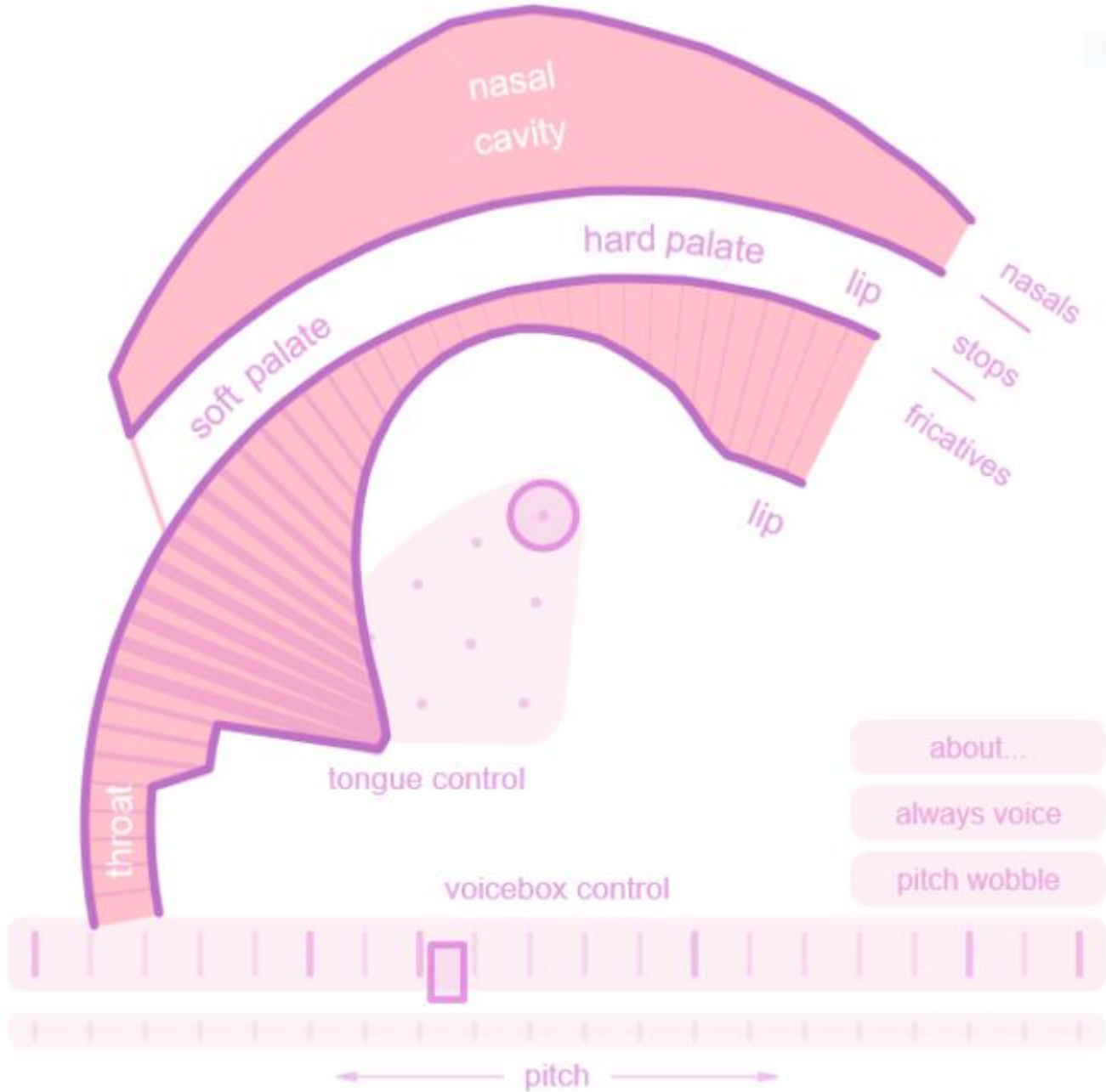
throat
about...
always voice
pitch wobble
voicebox control
pitch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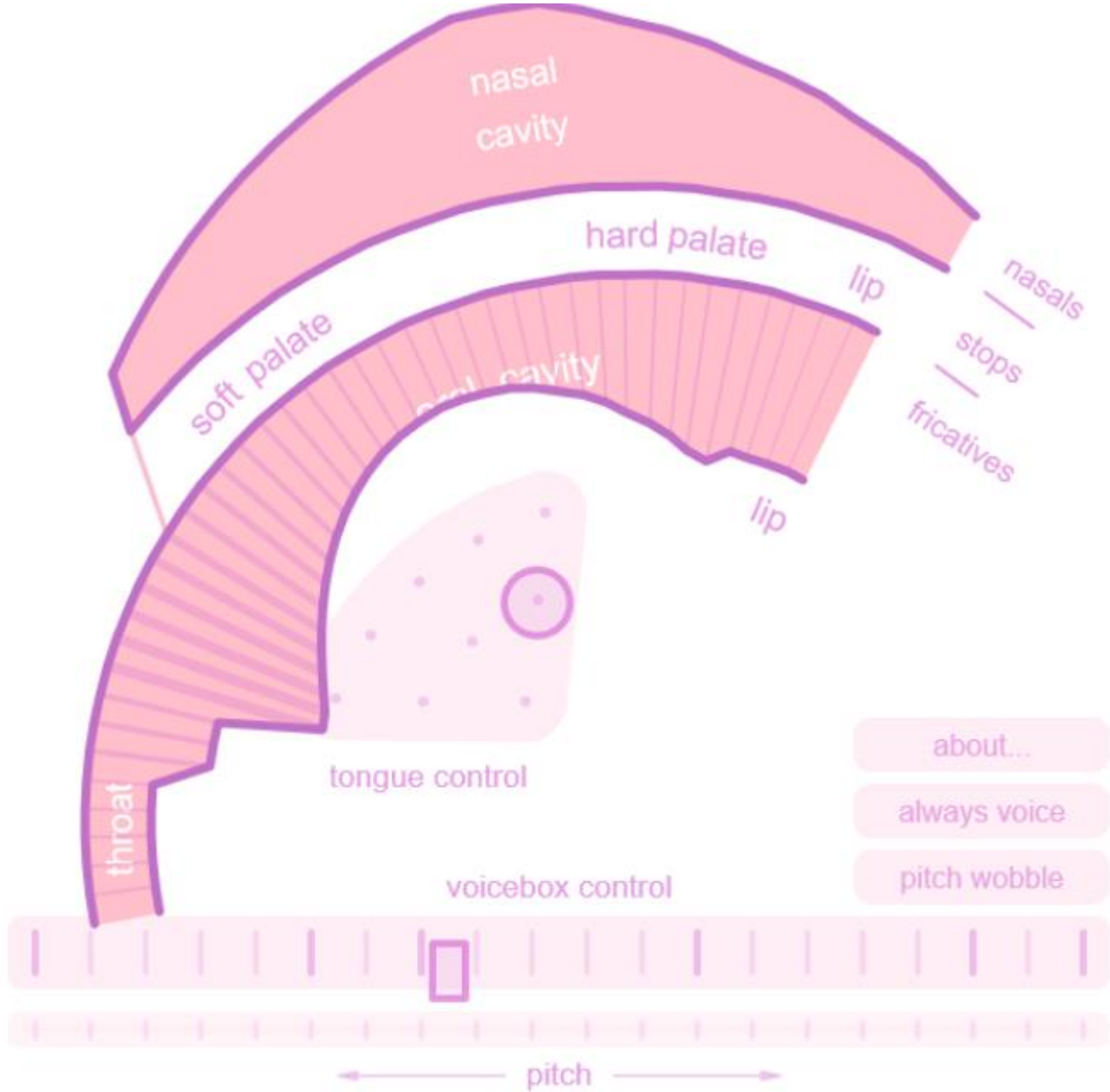
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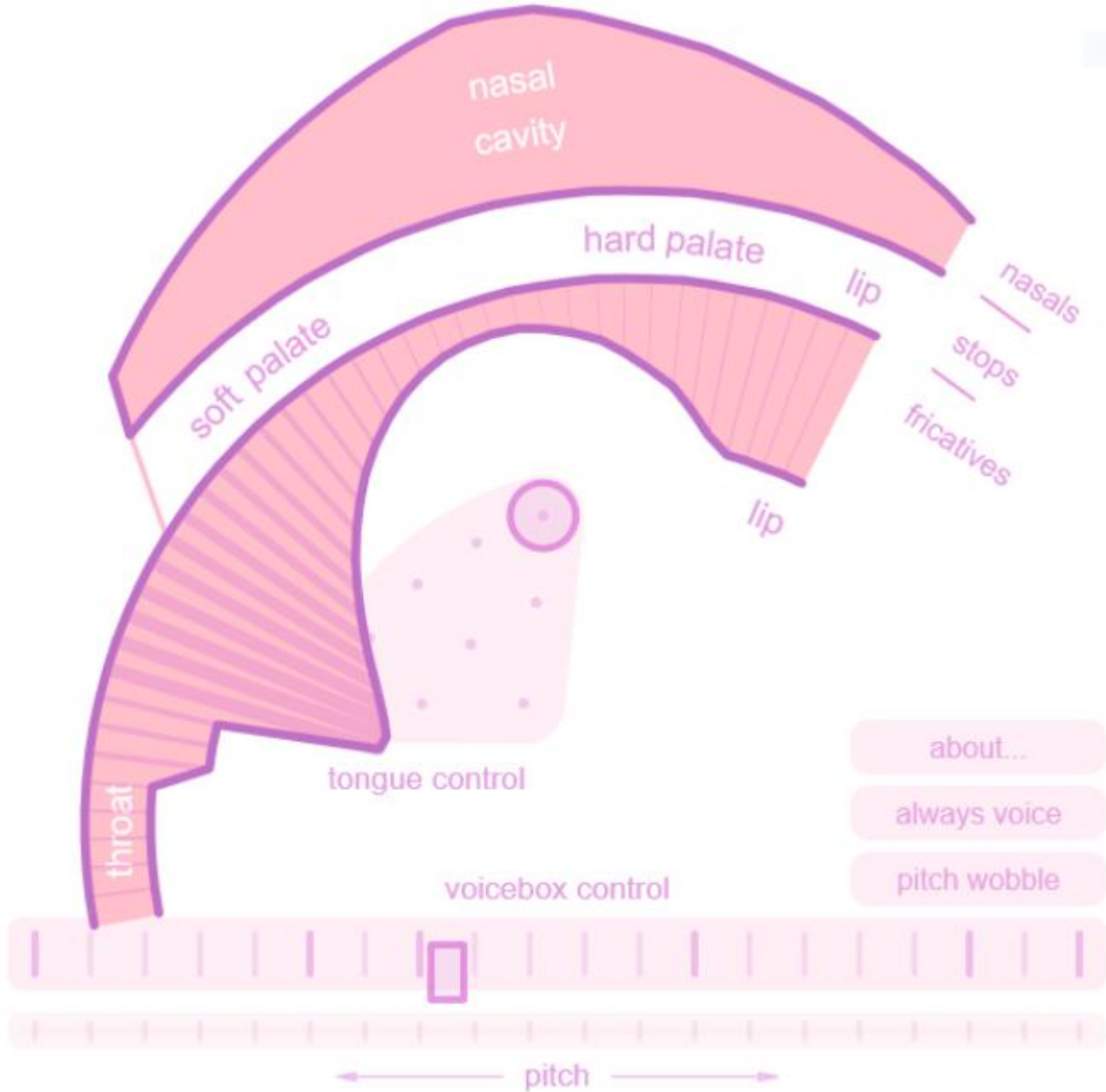
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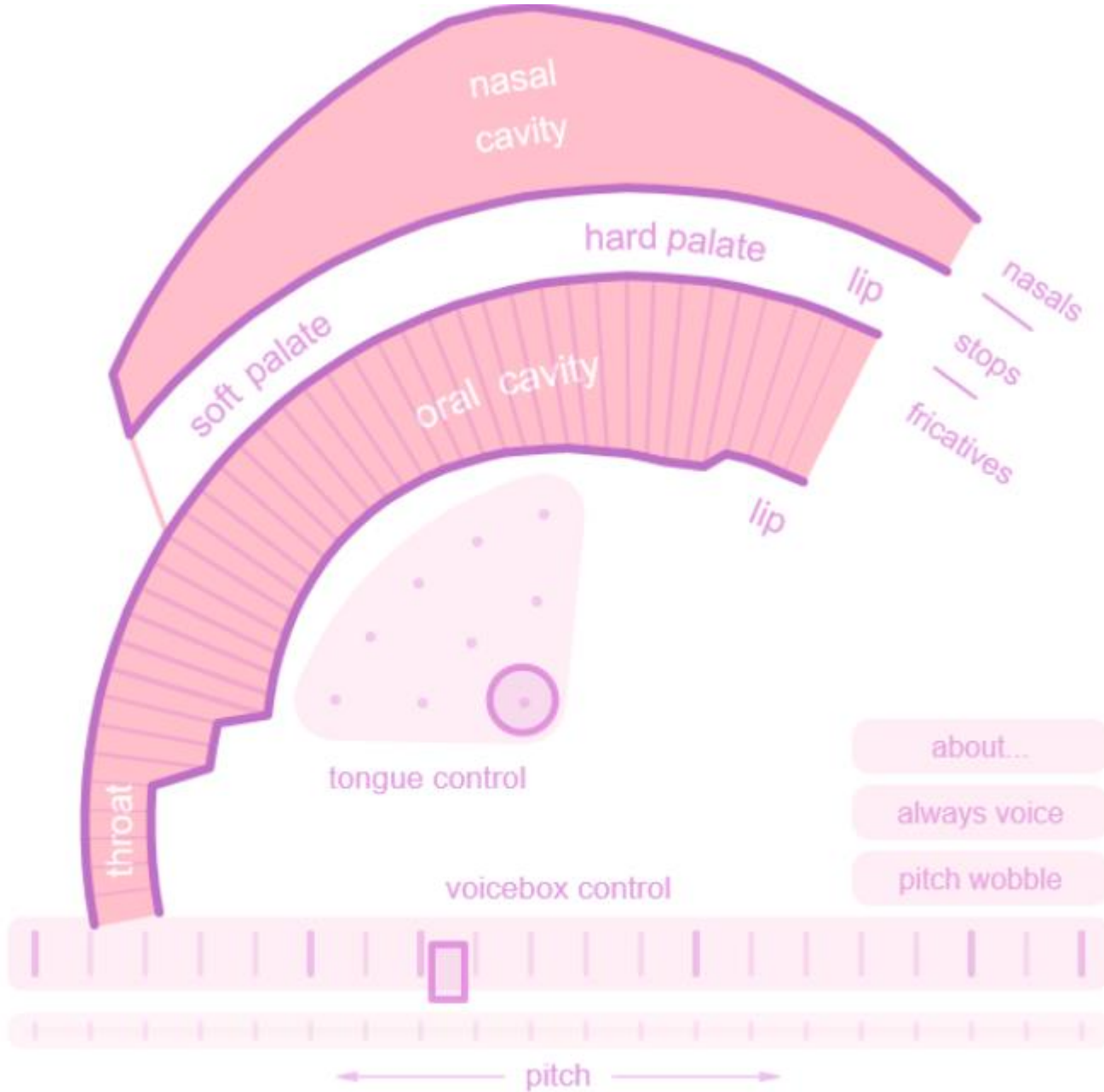
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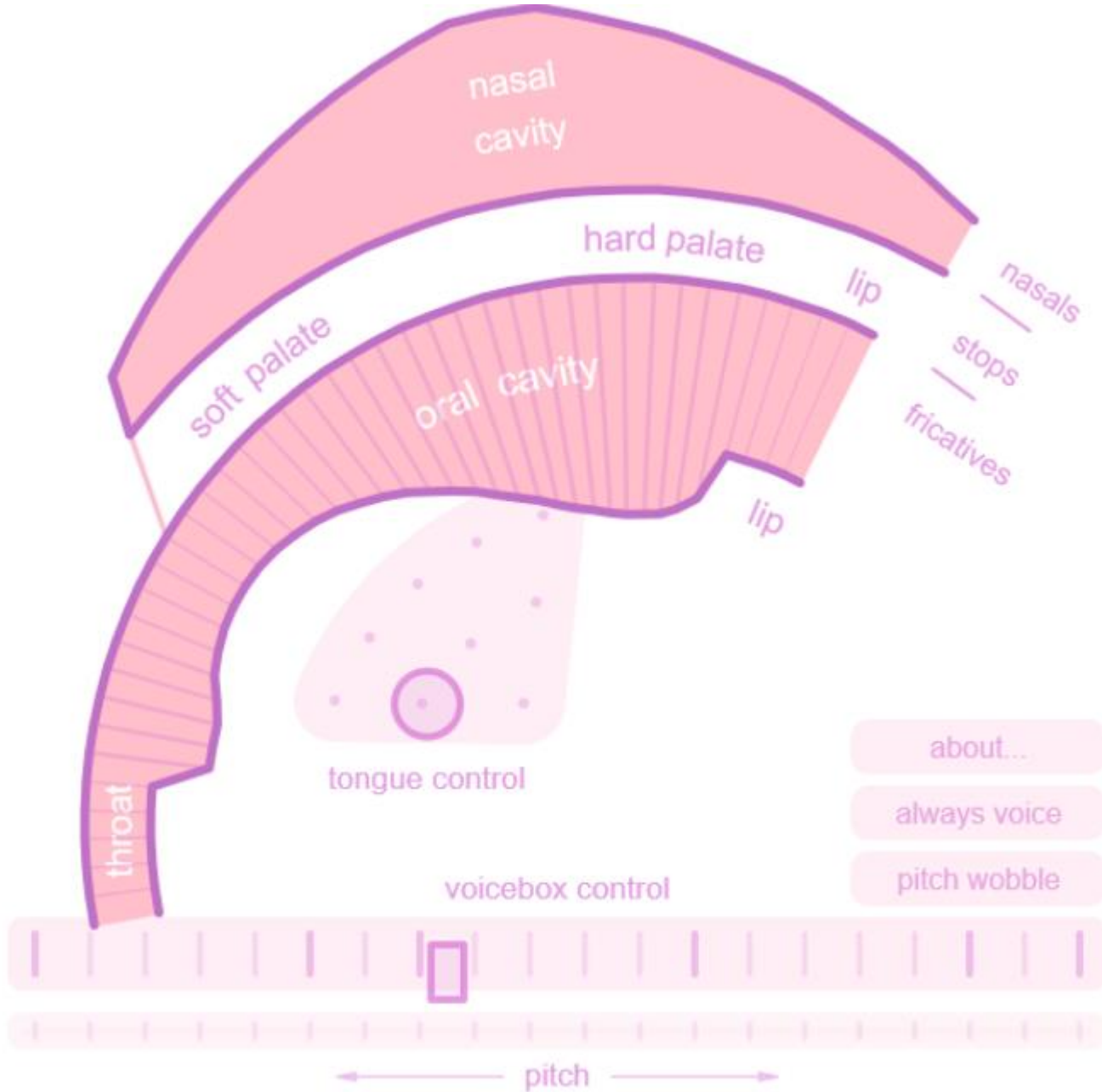
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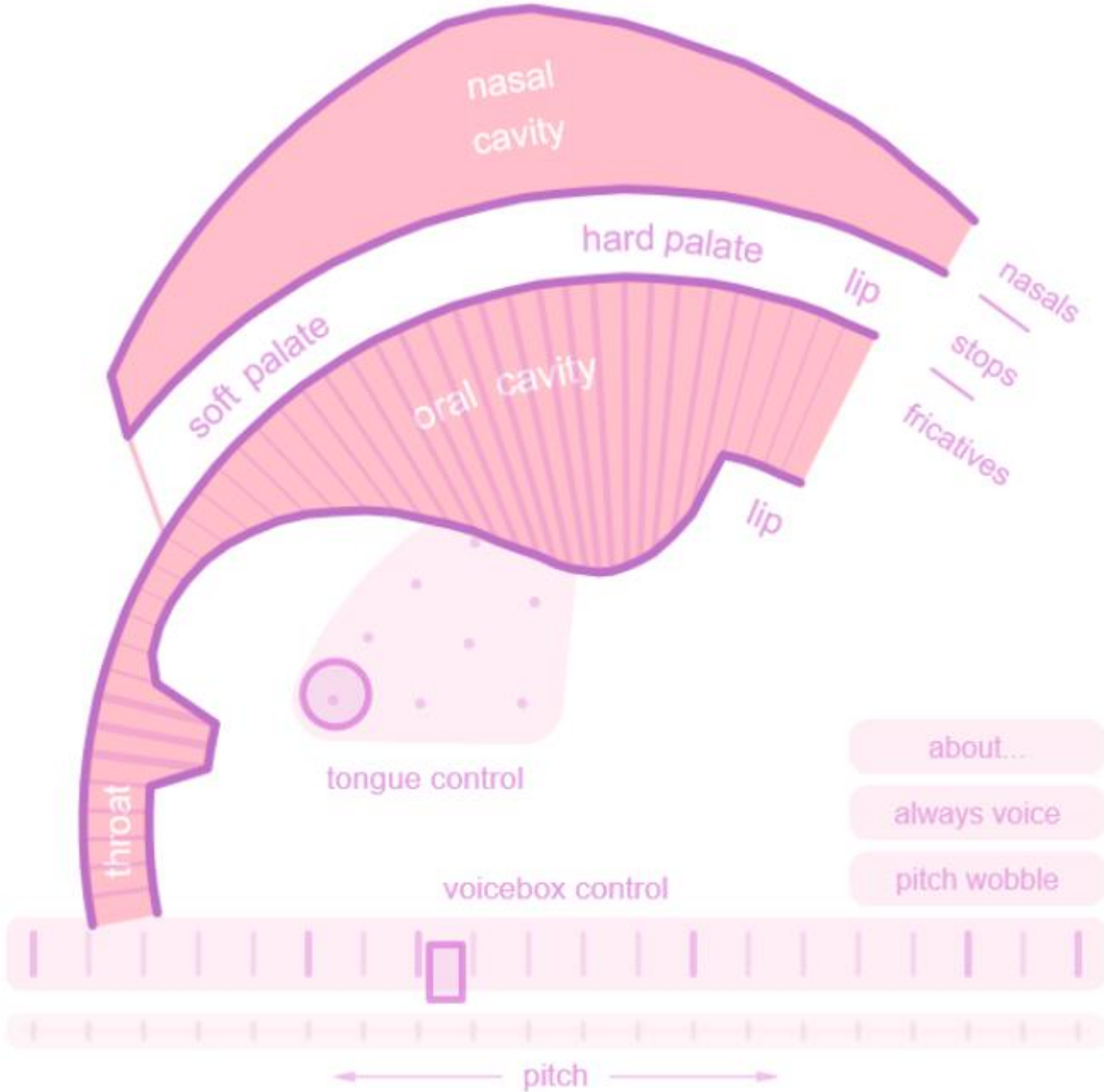
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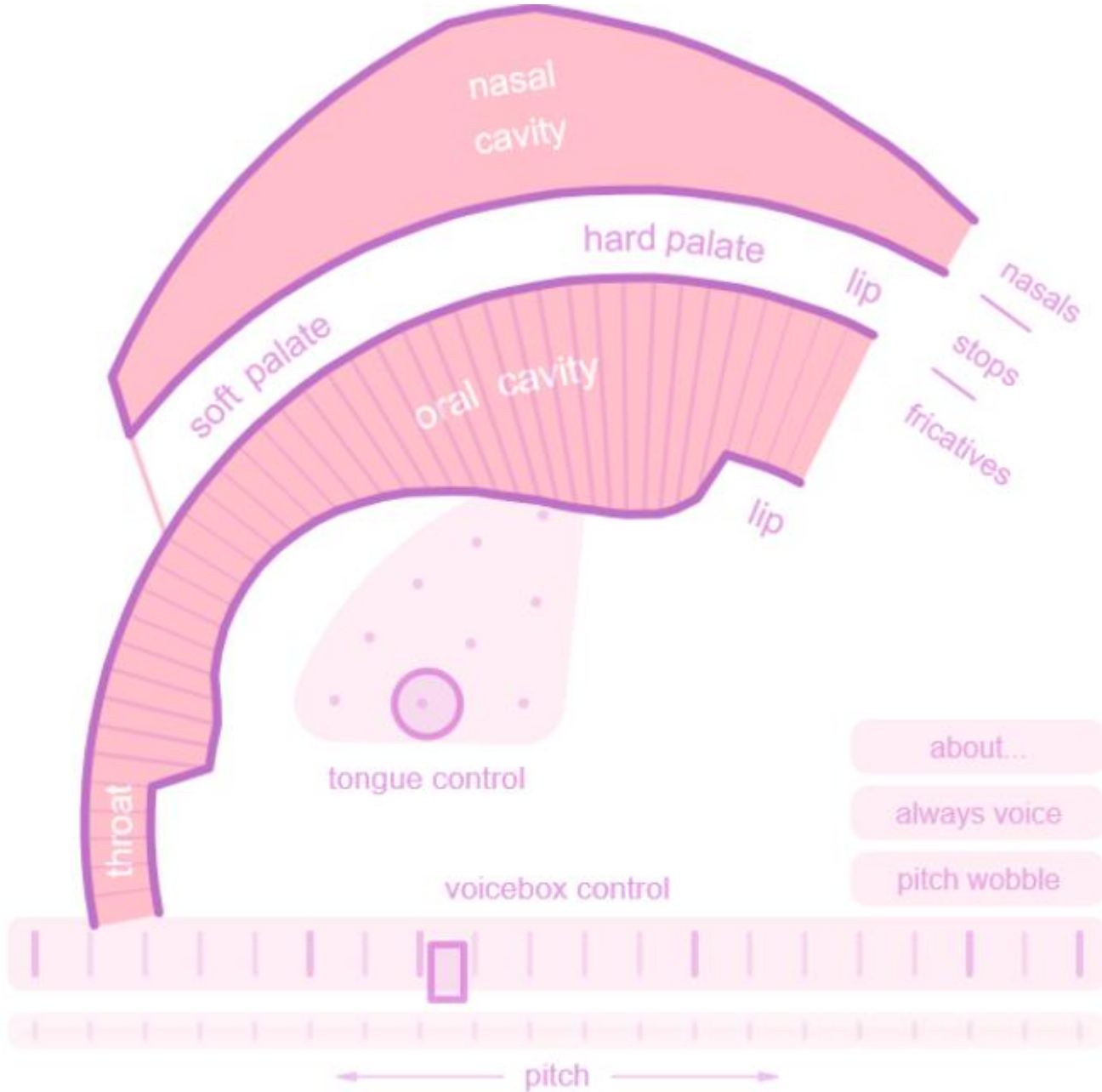
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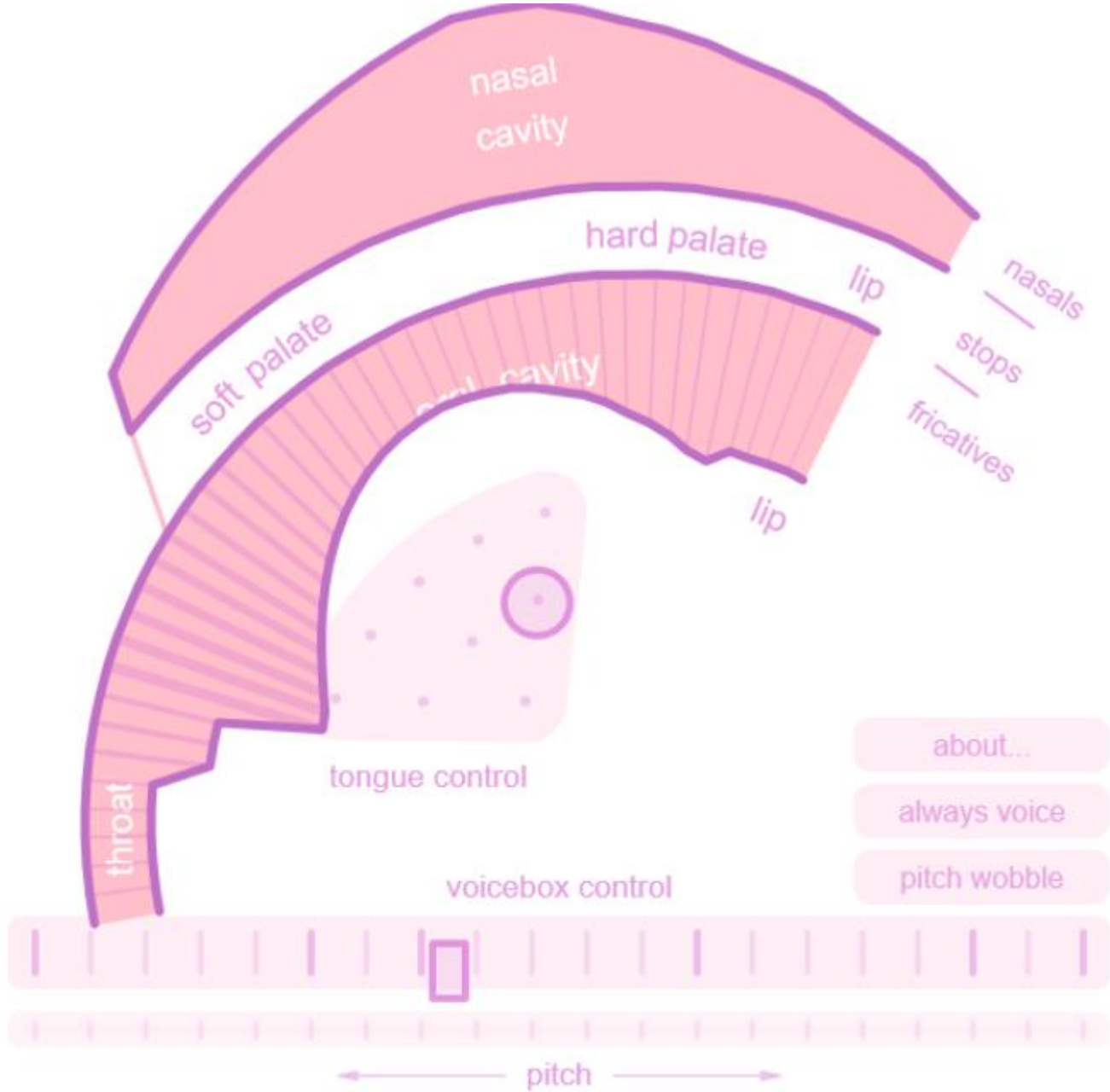
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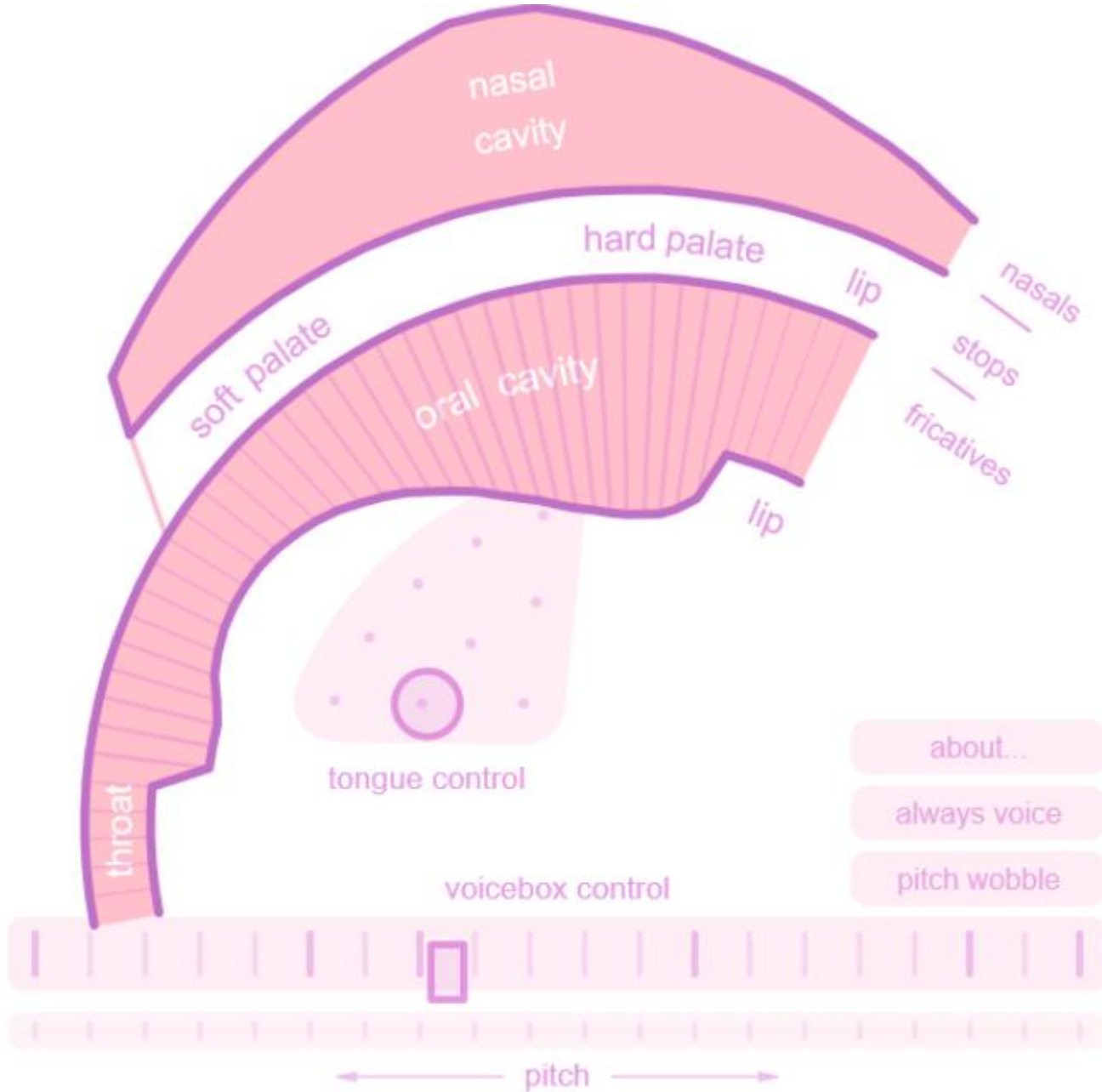
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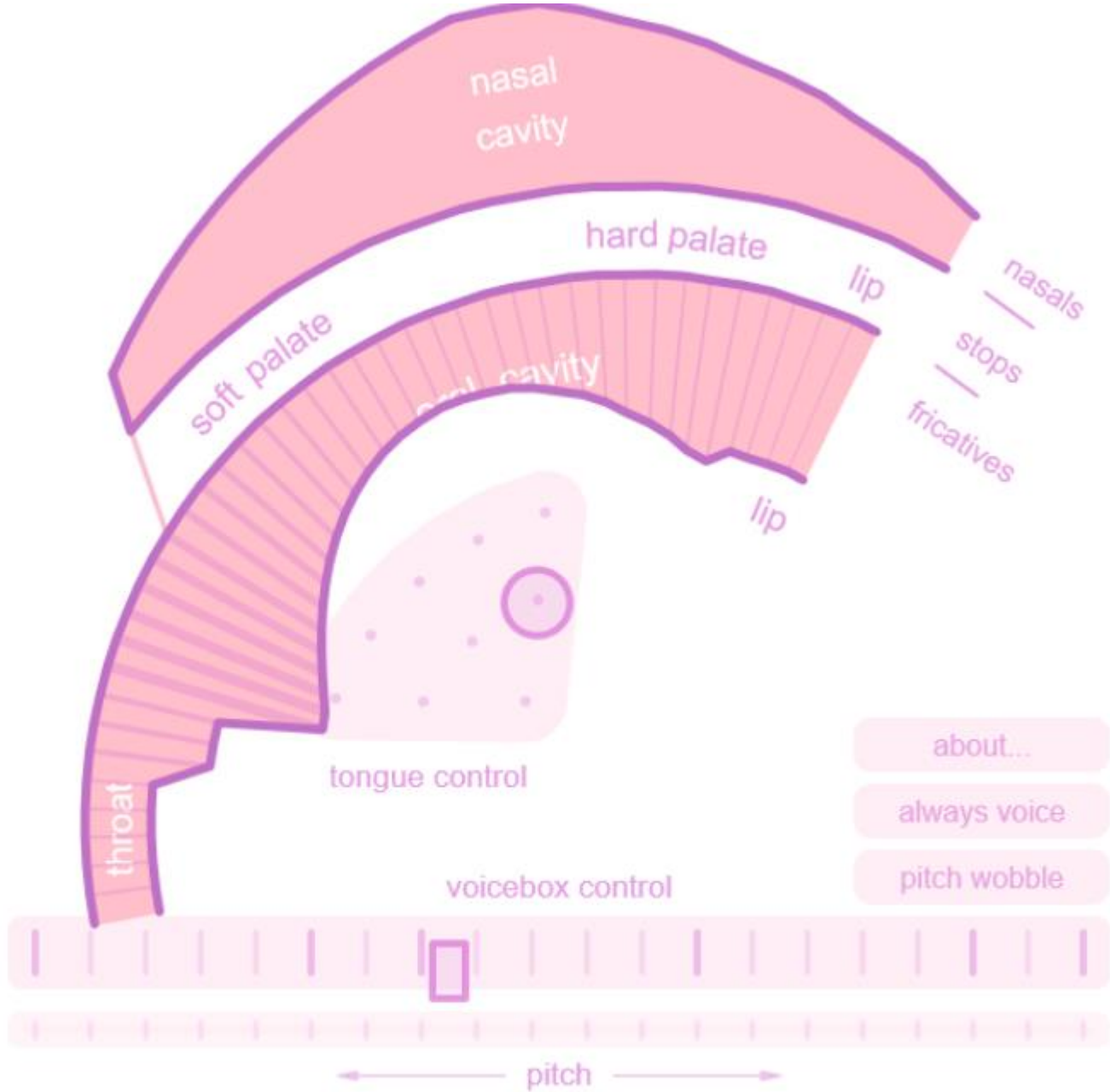
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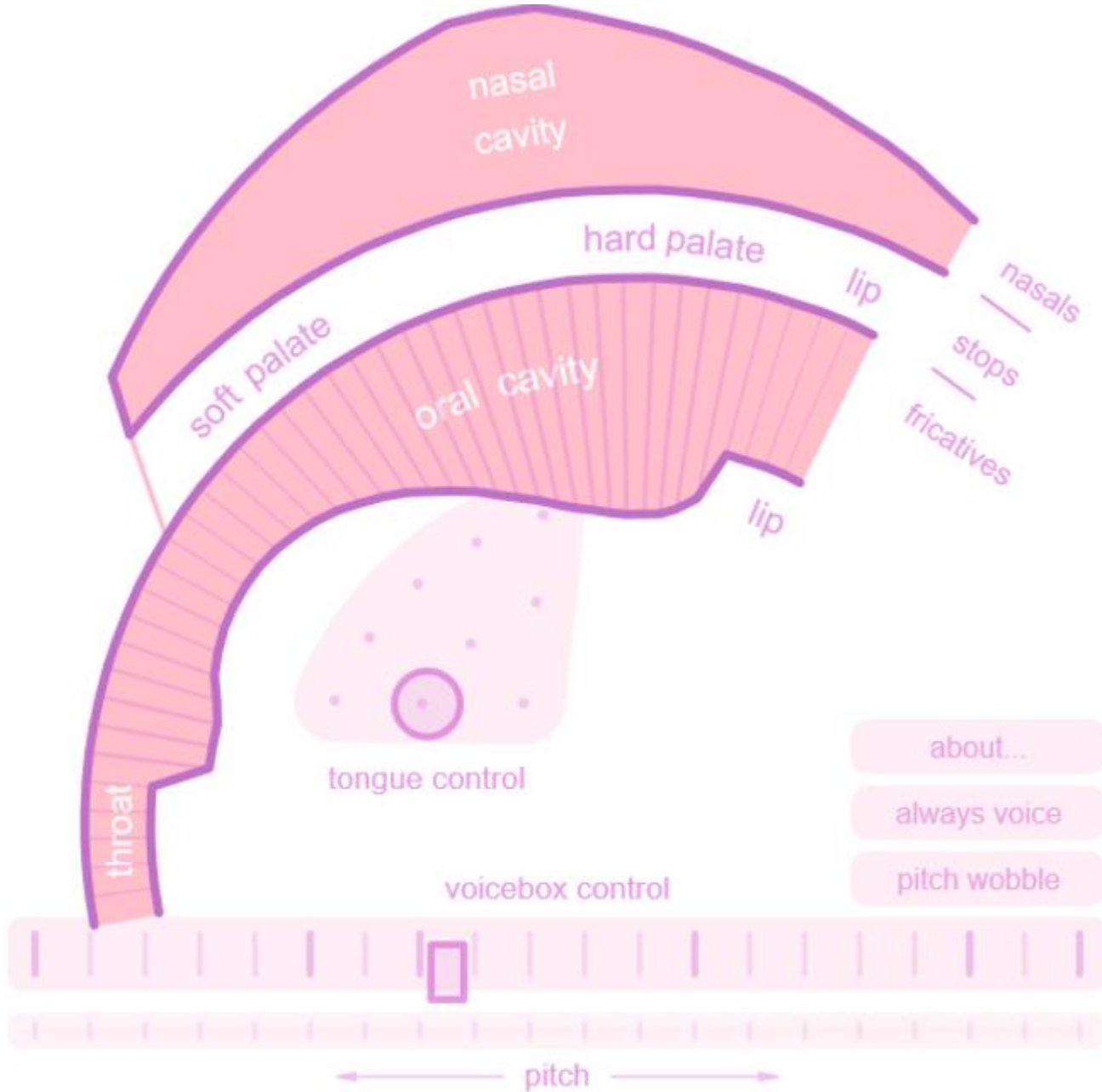
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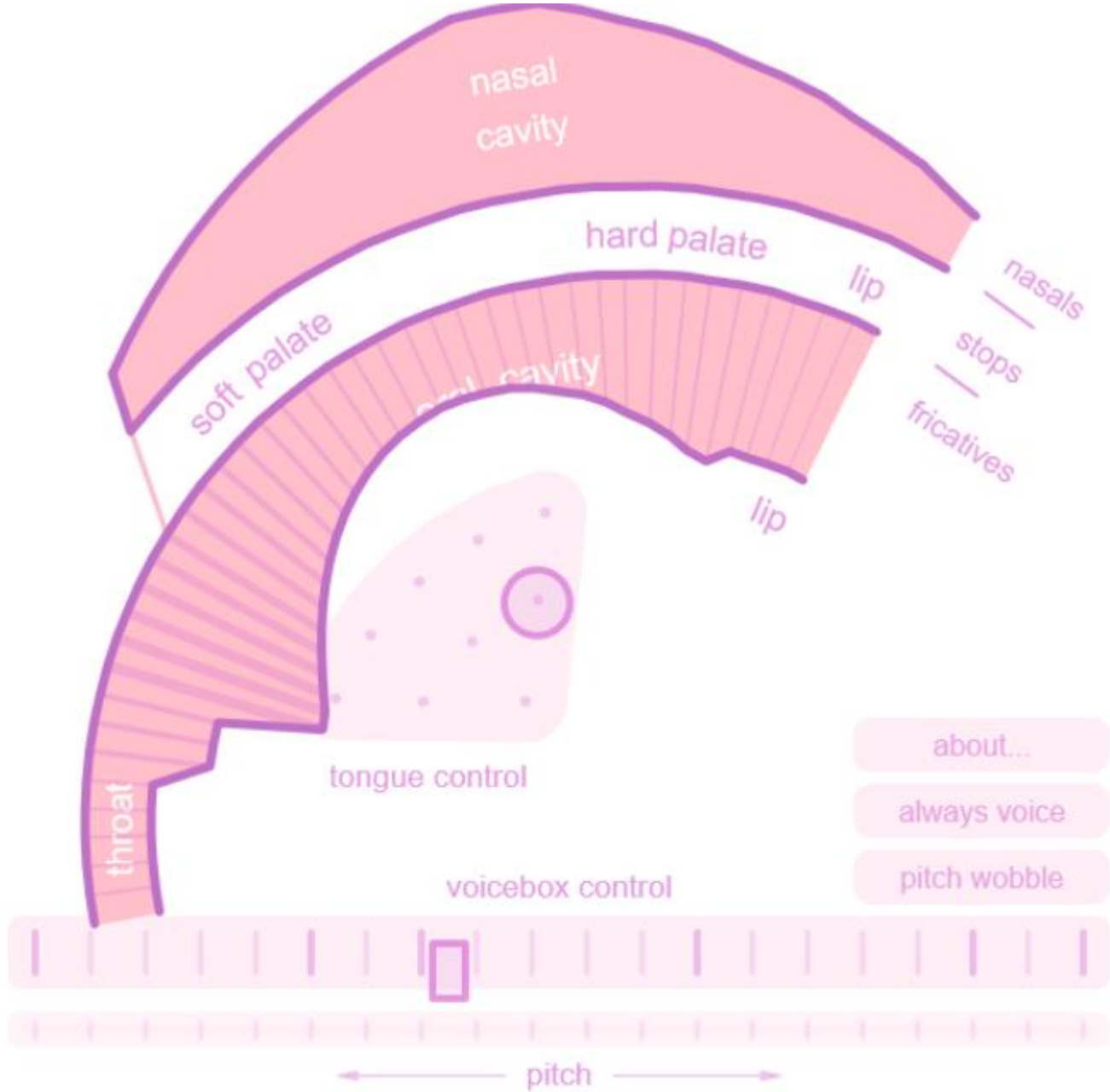
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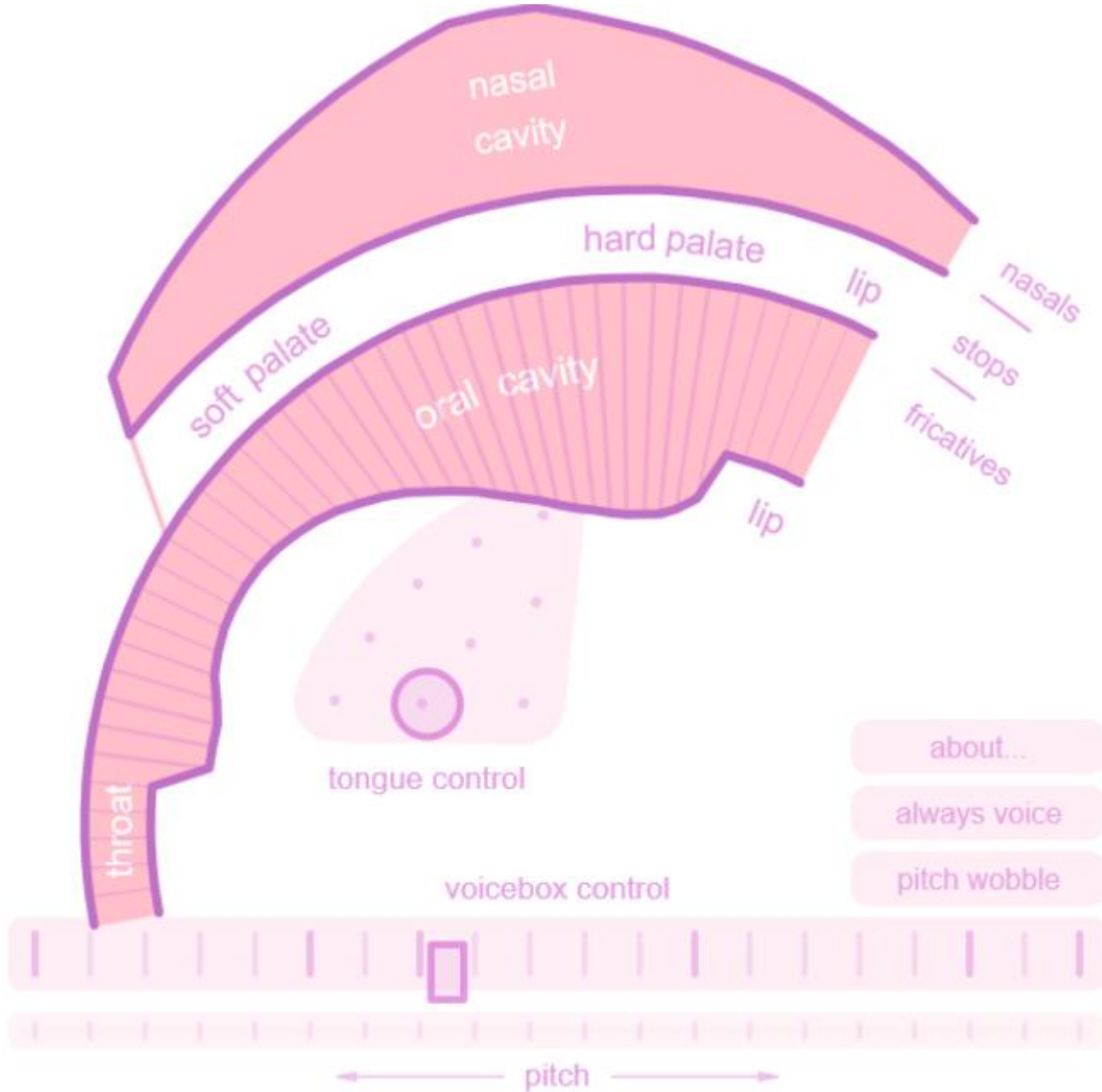
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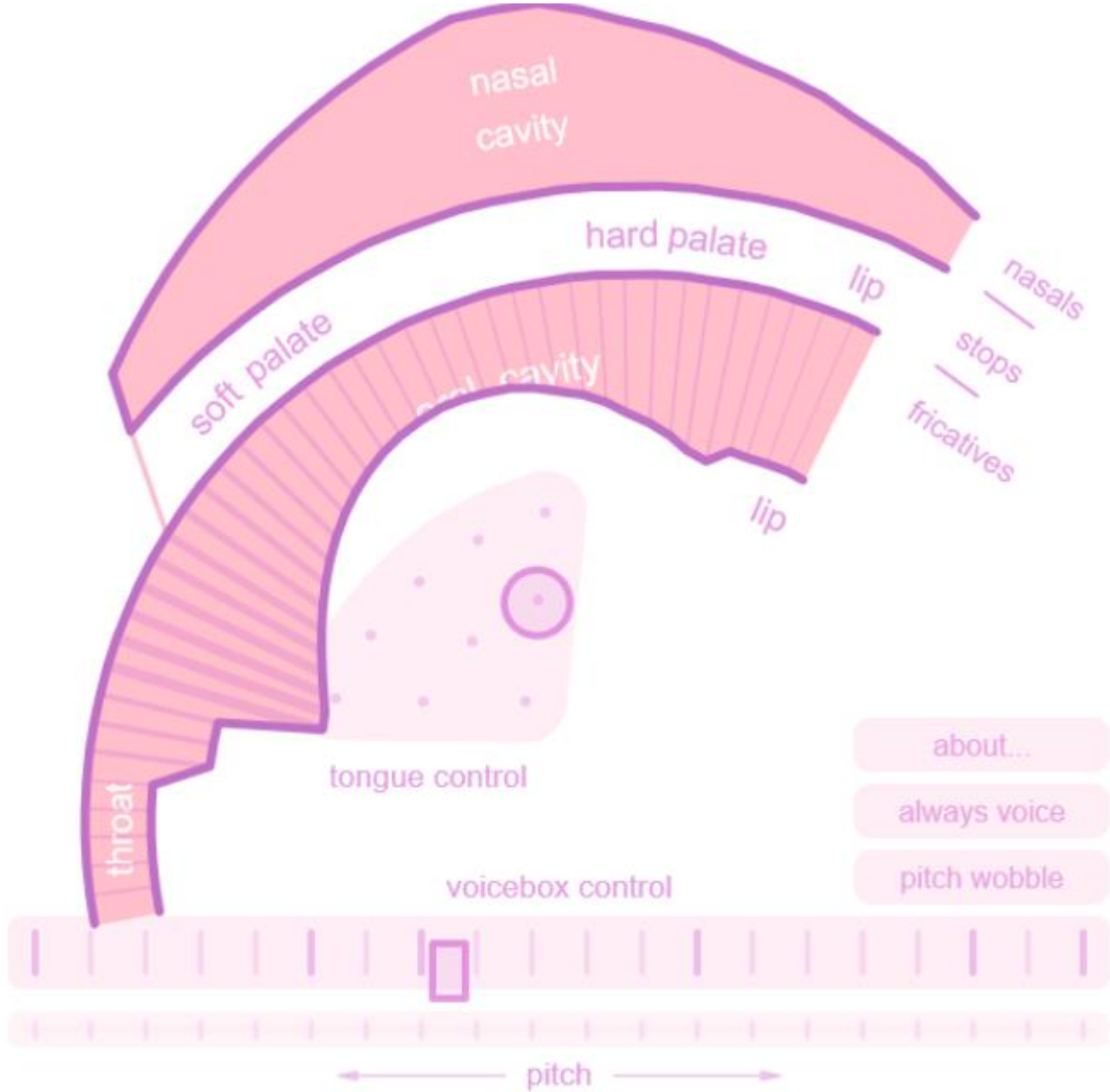
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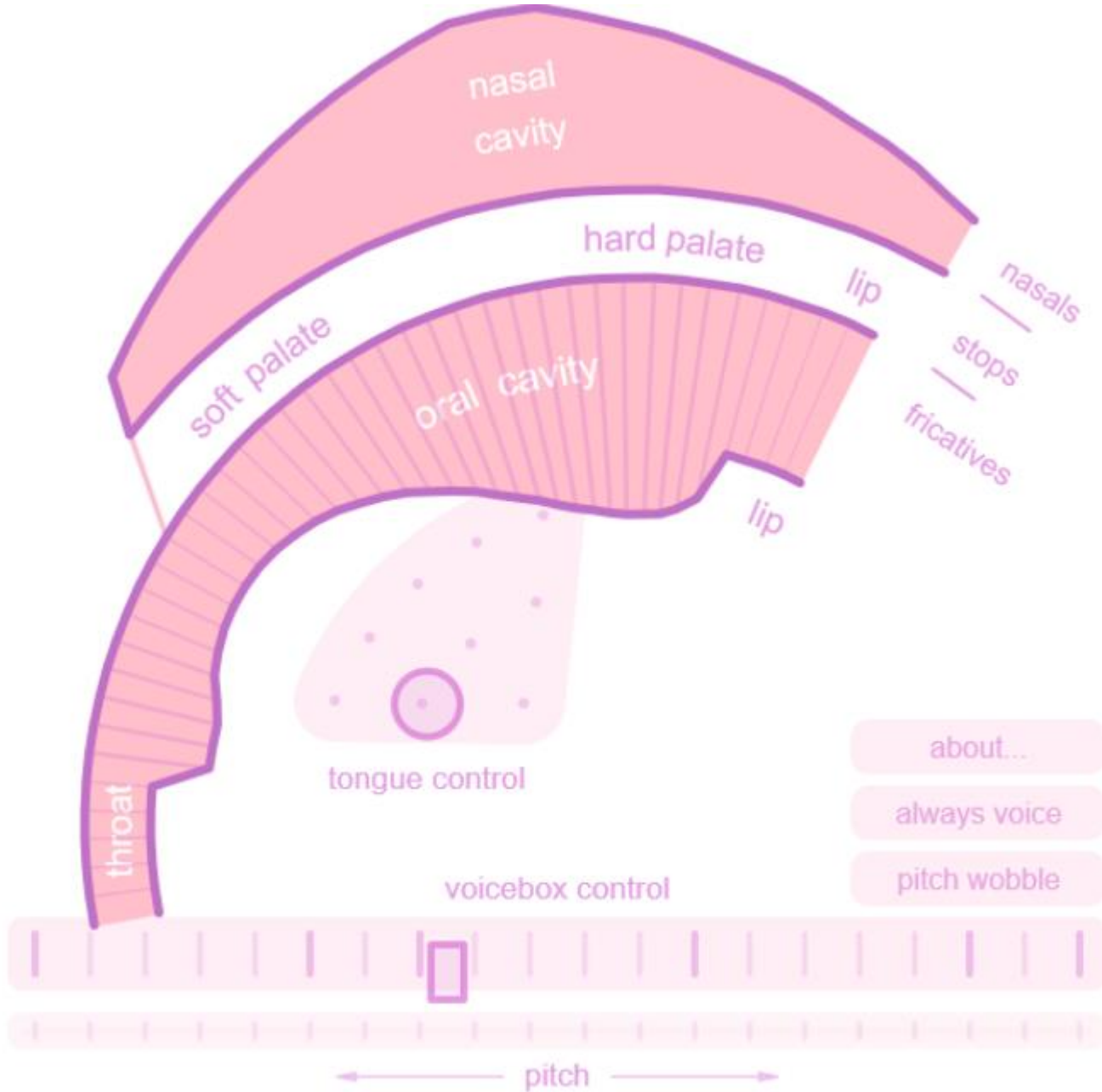
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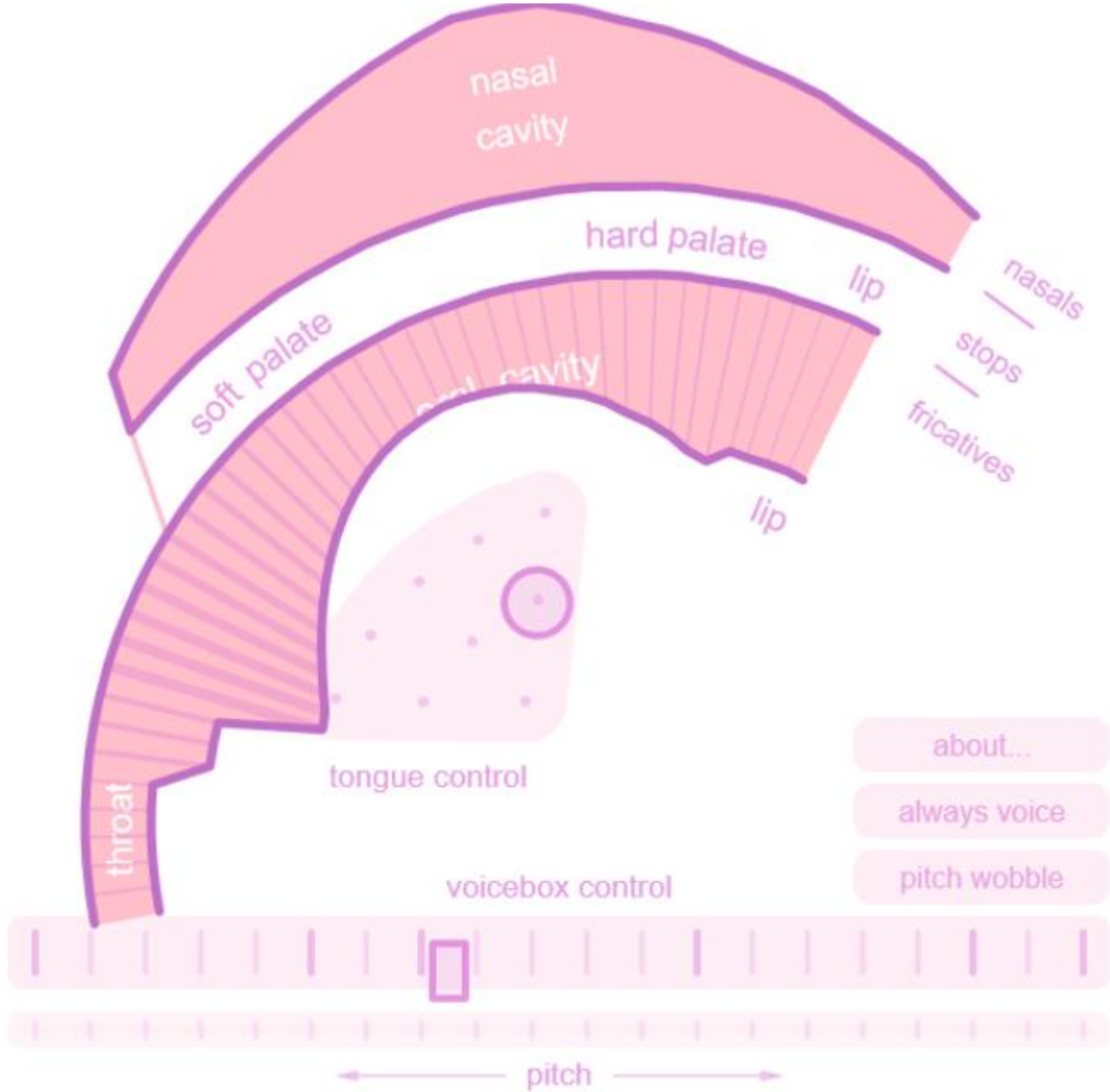
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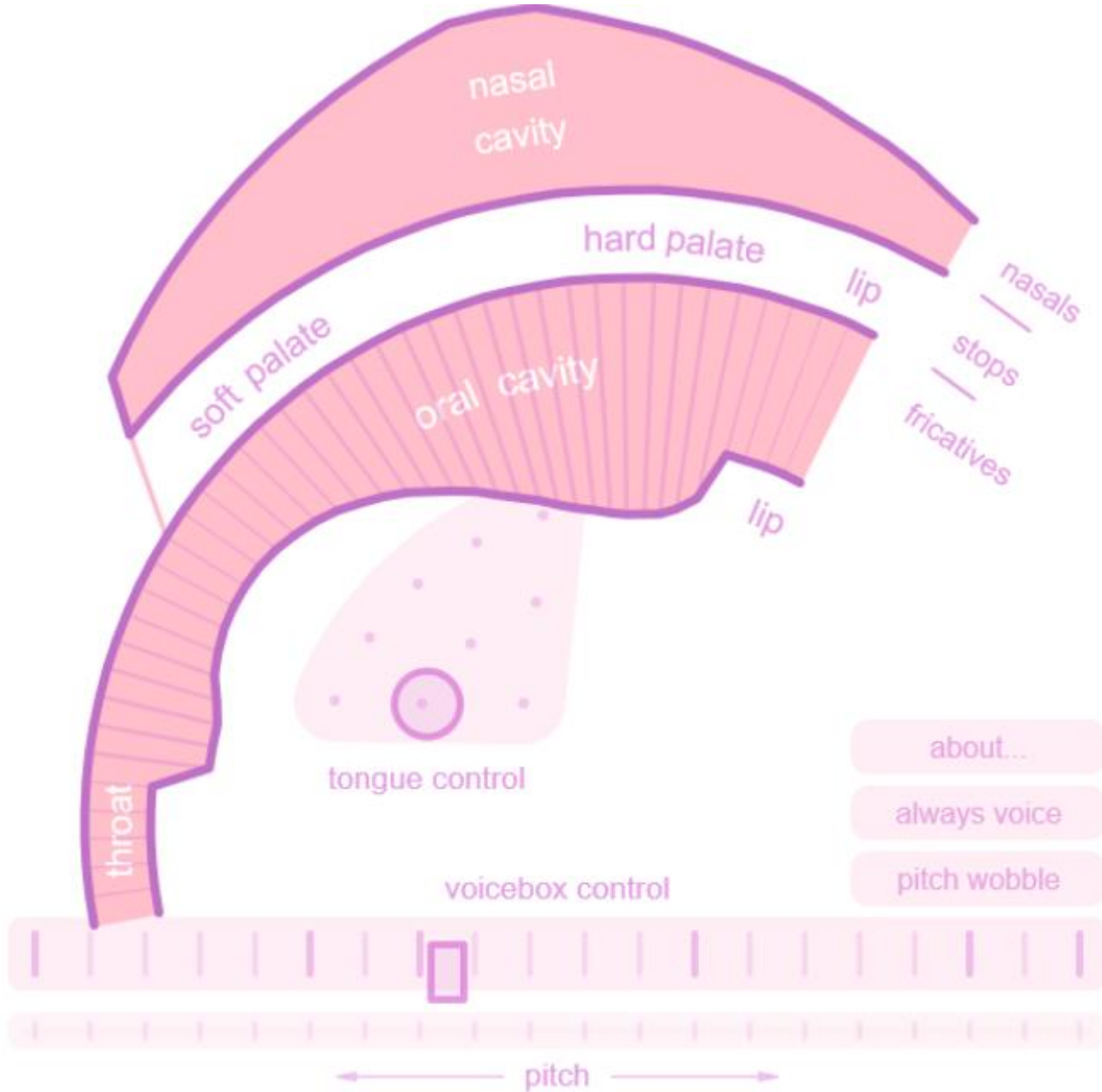
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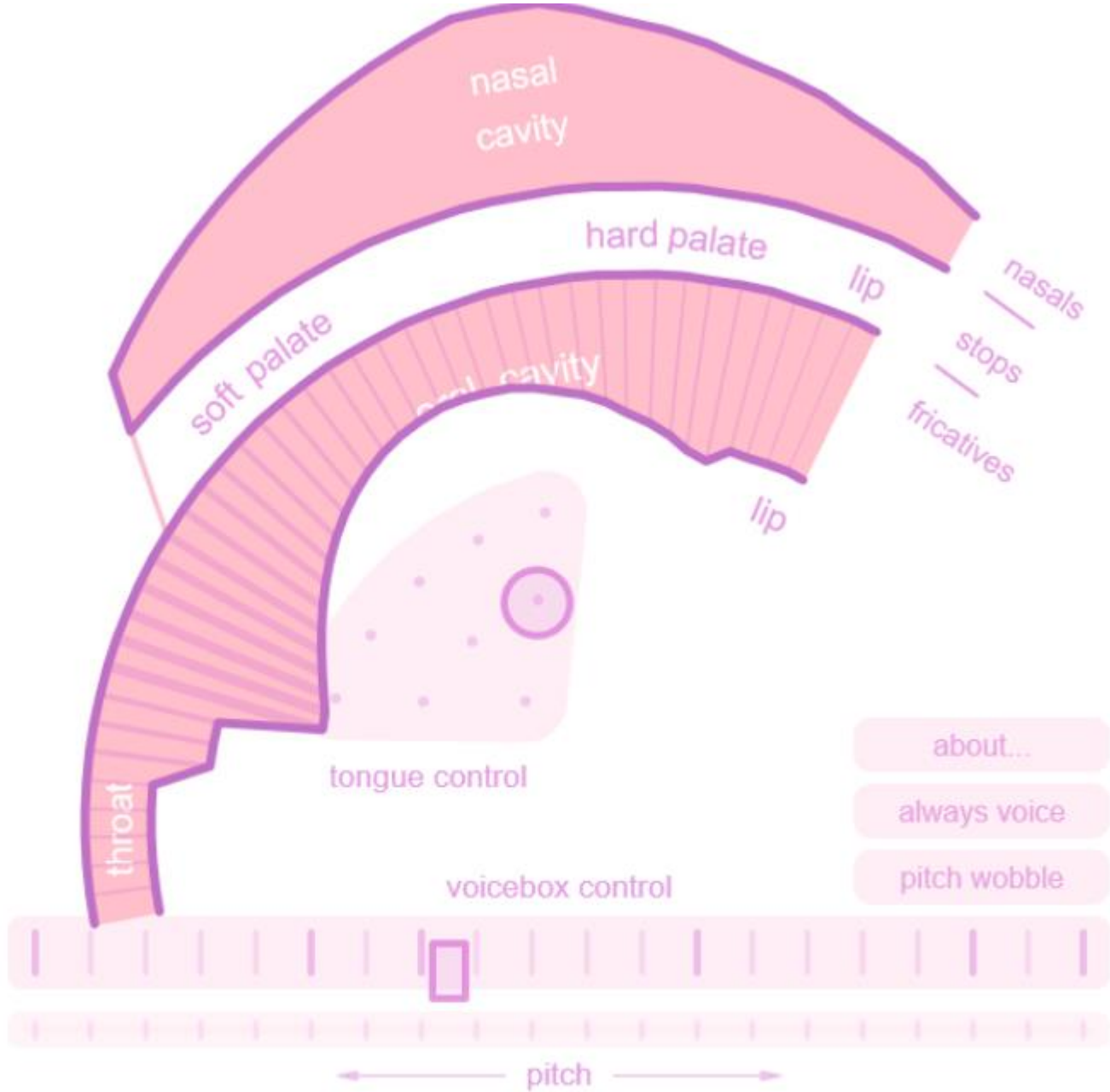
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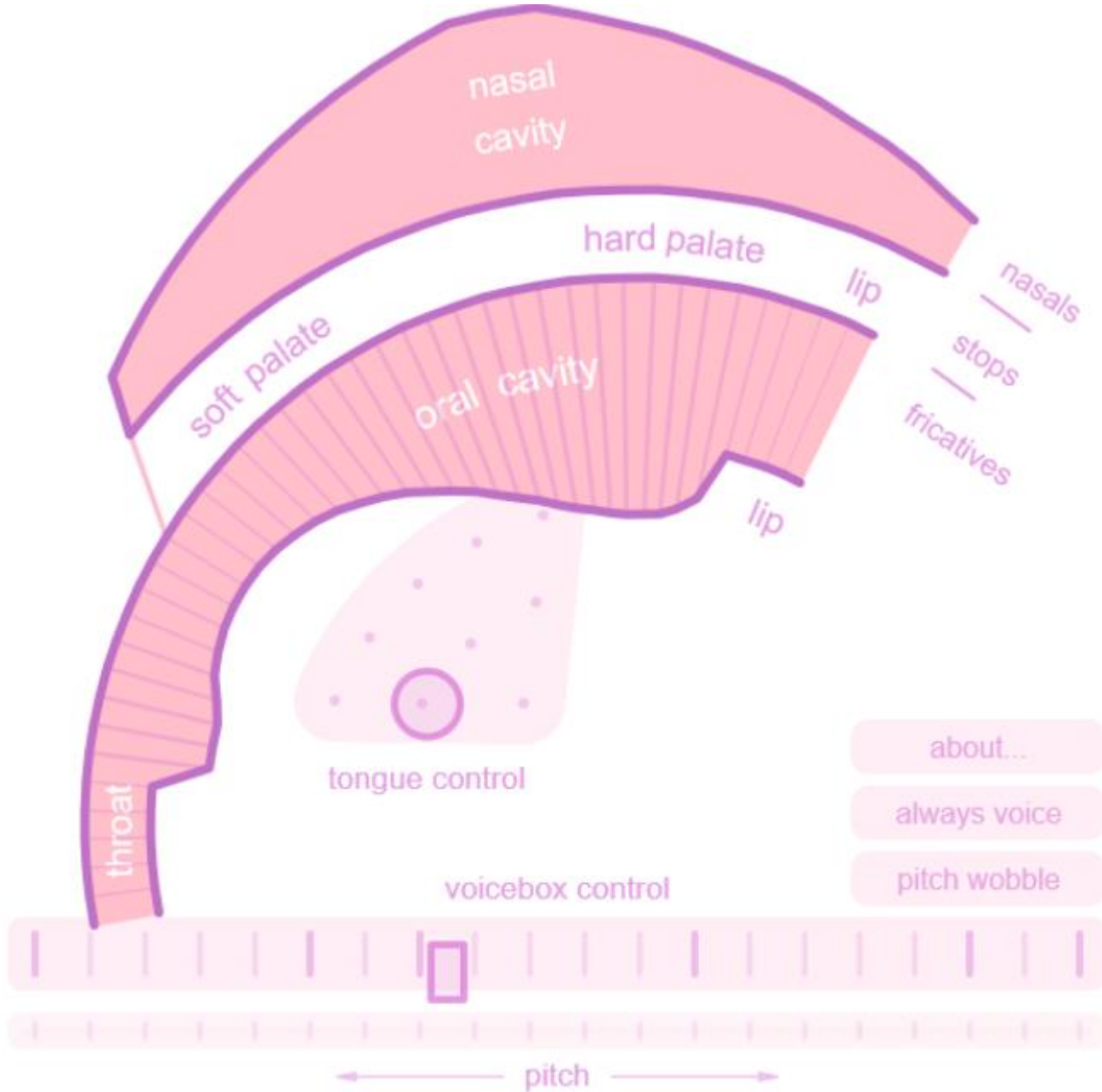
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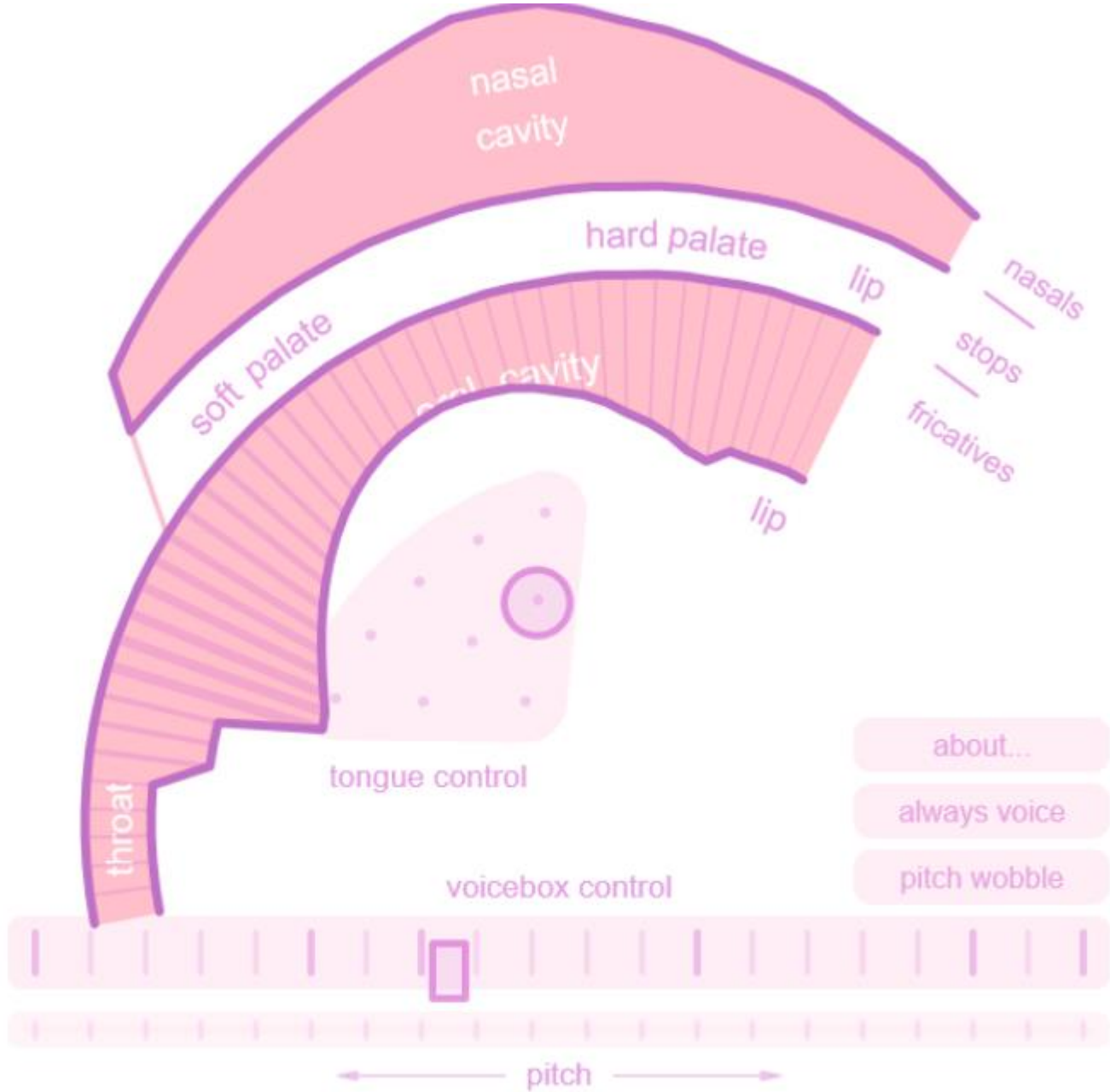
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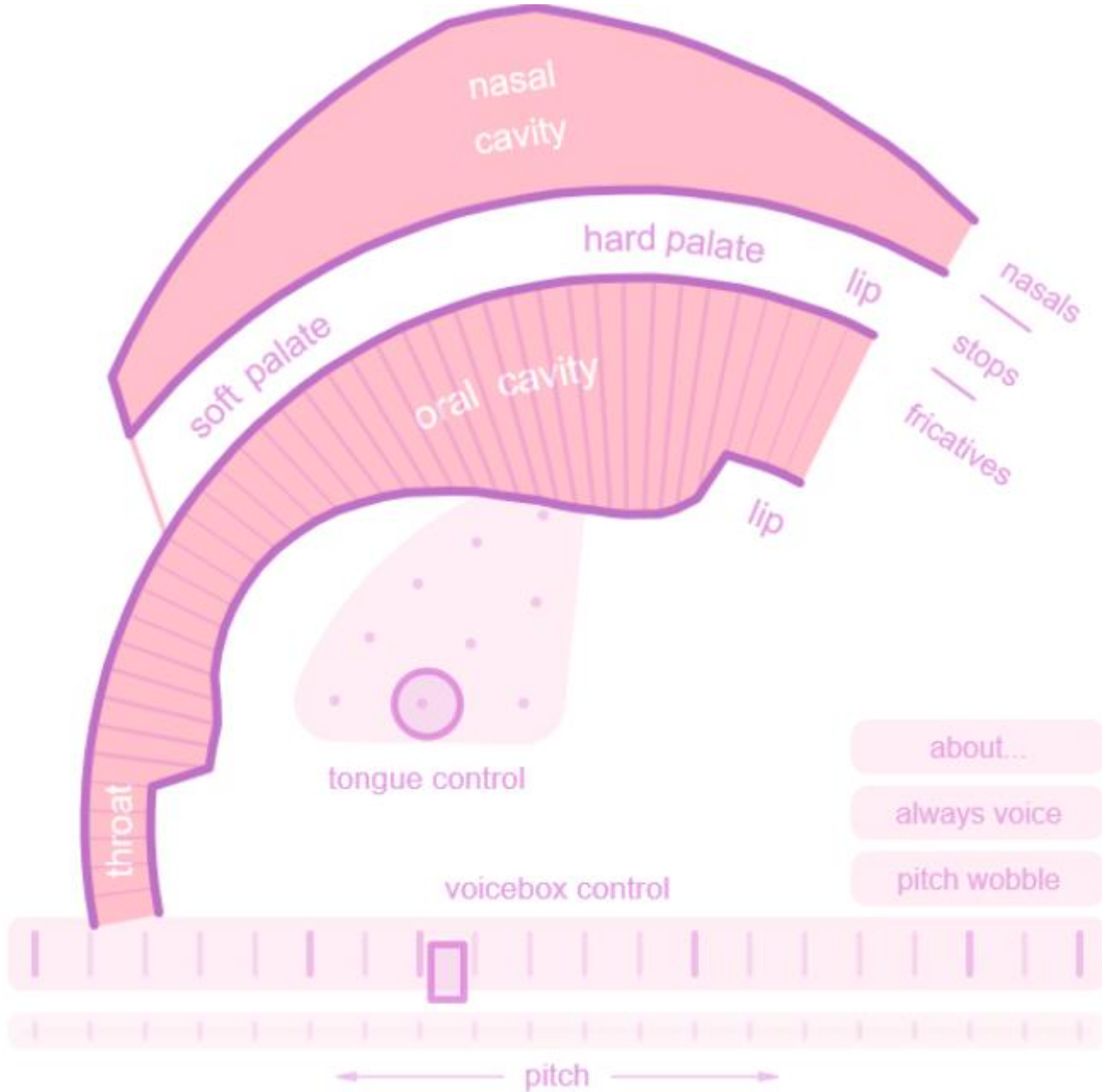
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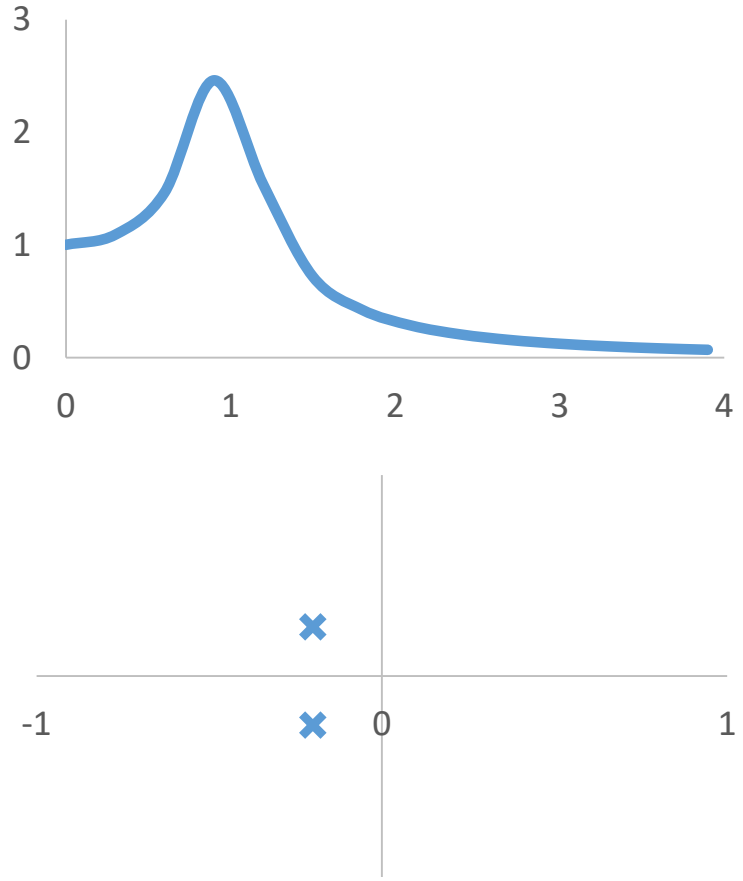
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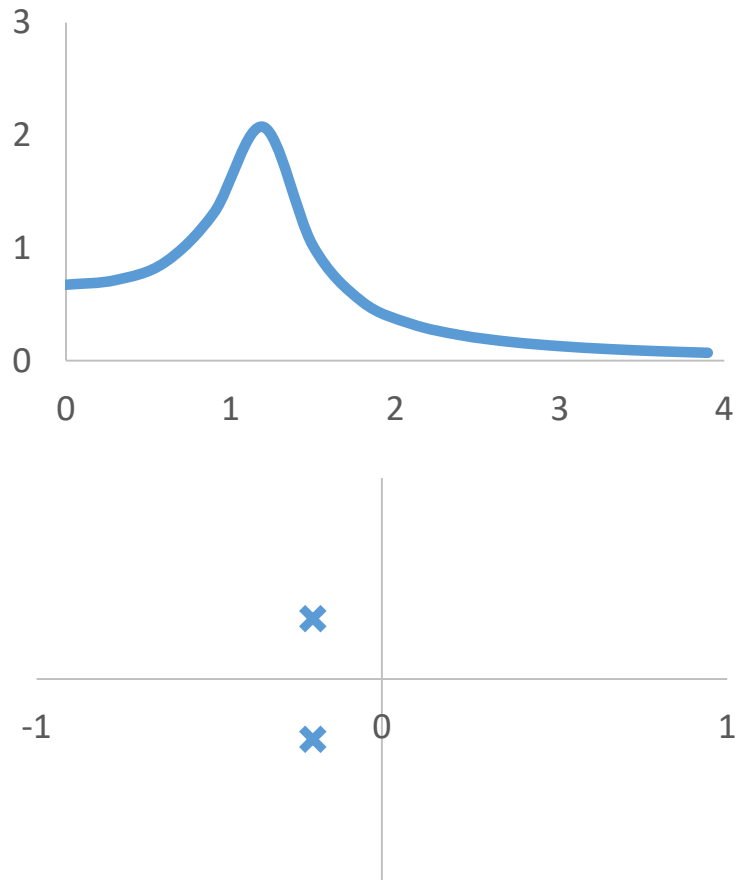
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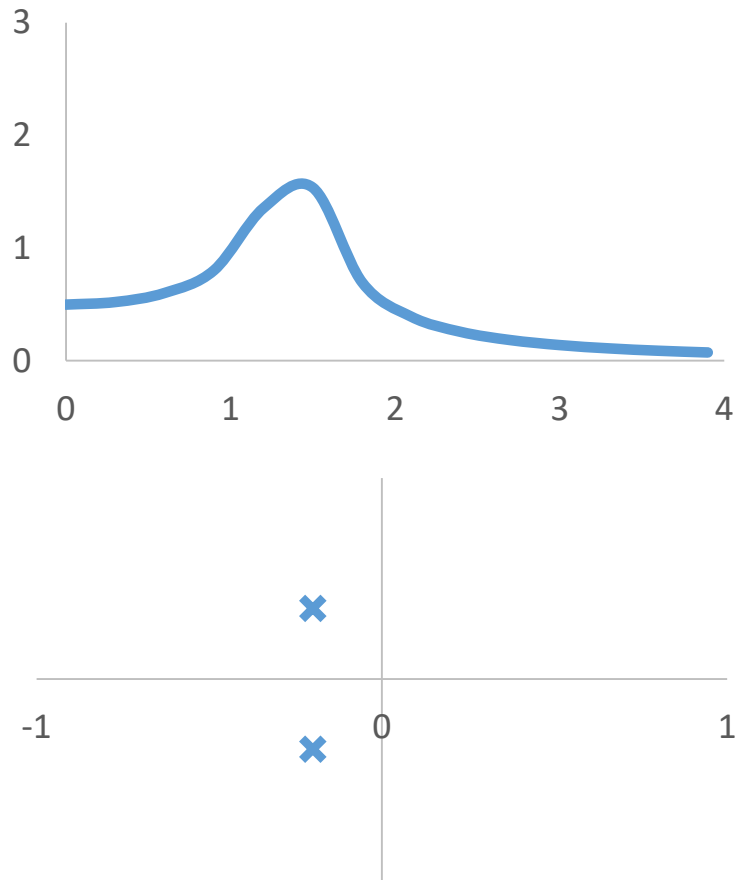
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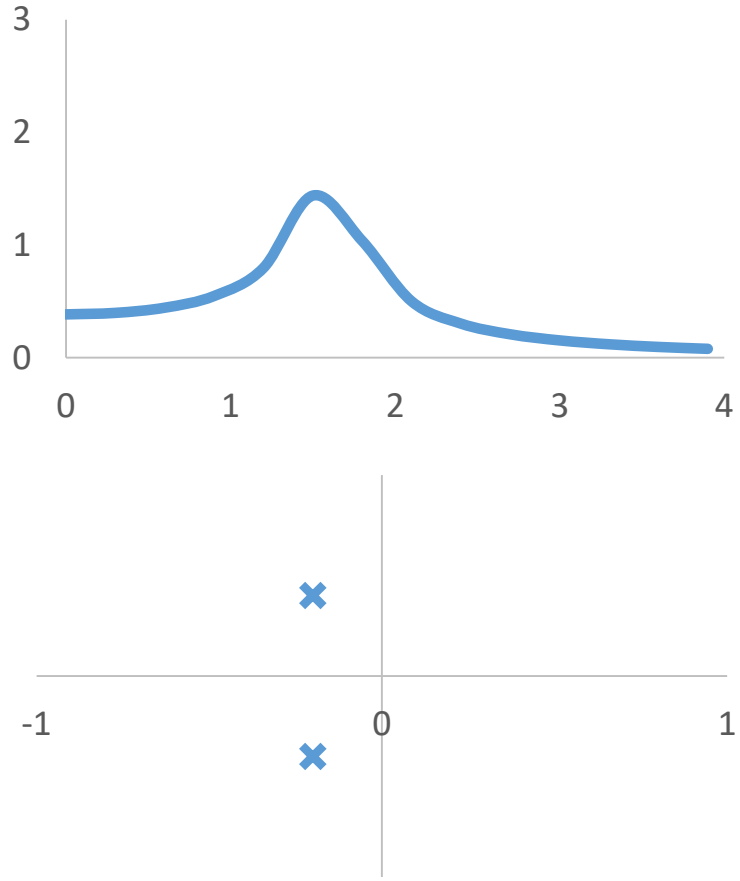
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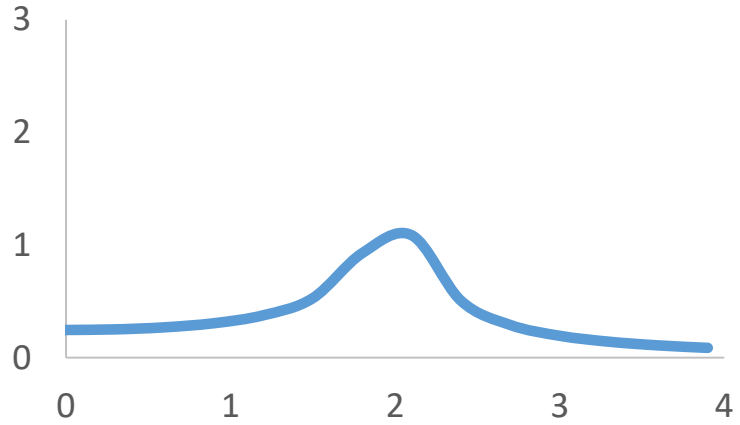
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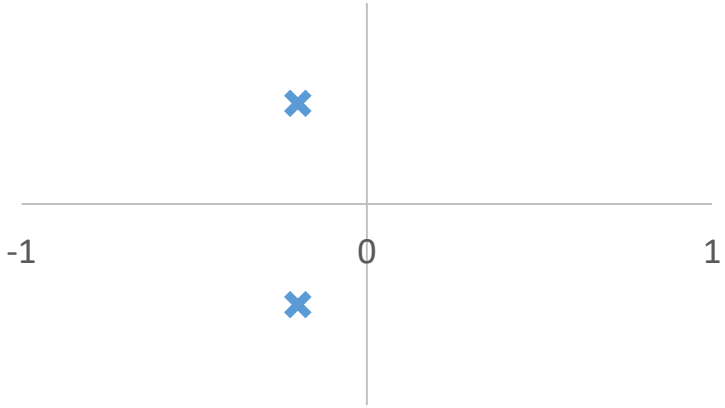
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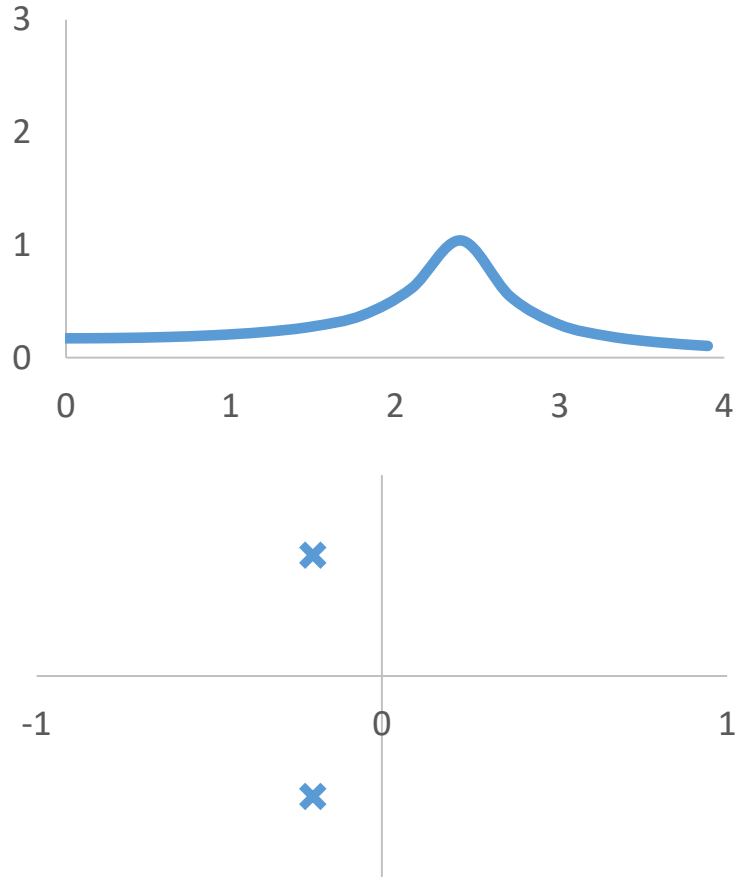
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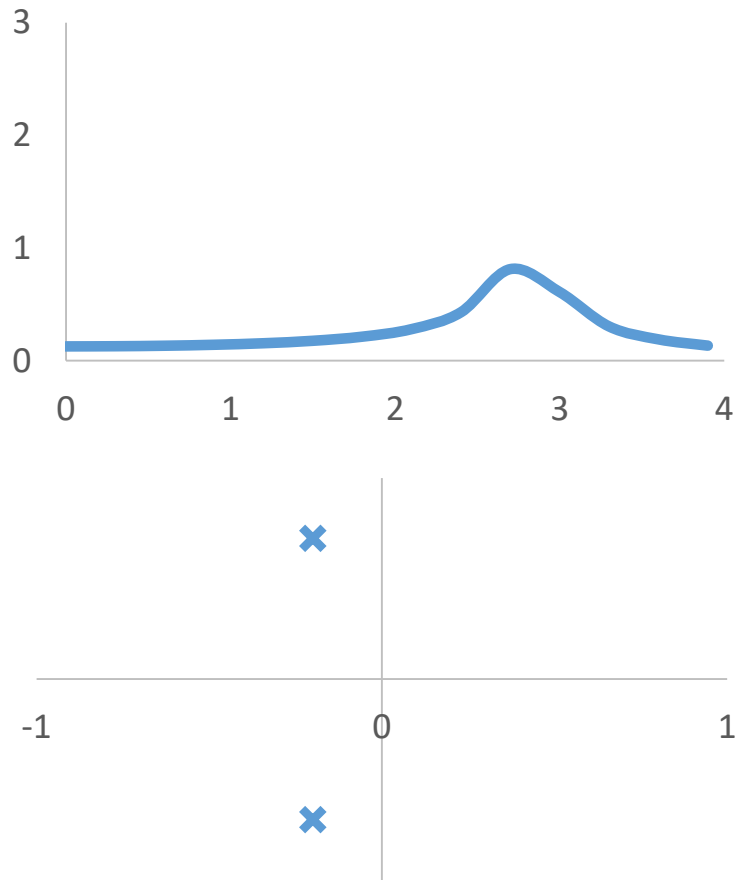
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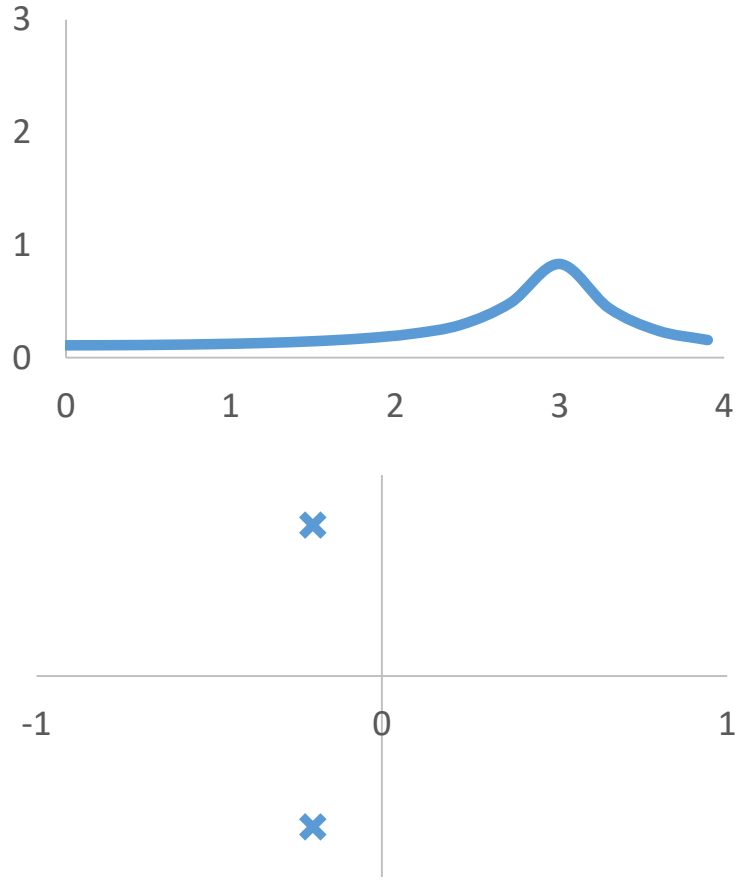
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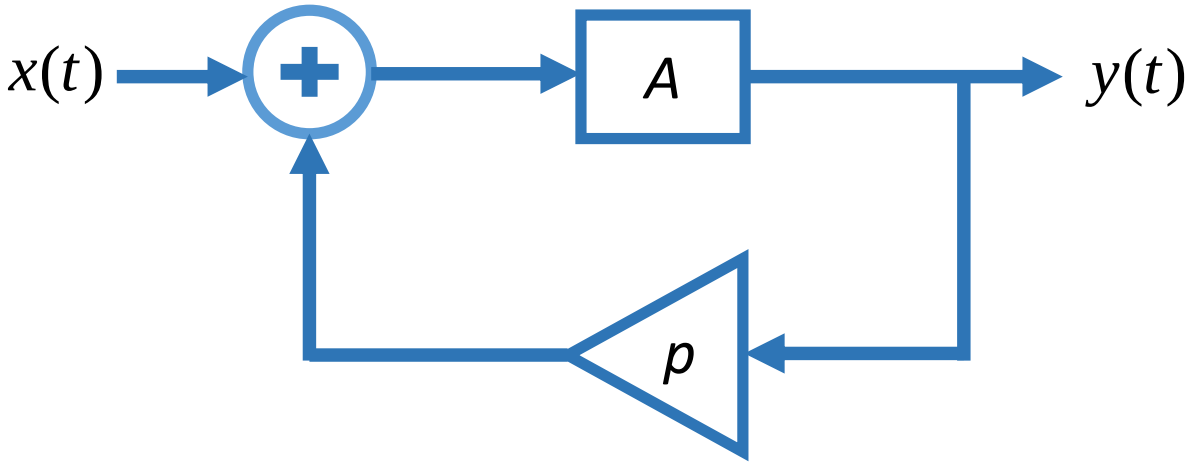
Mapping CT system to DT system

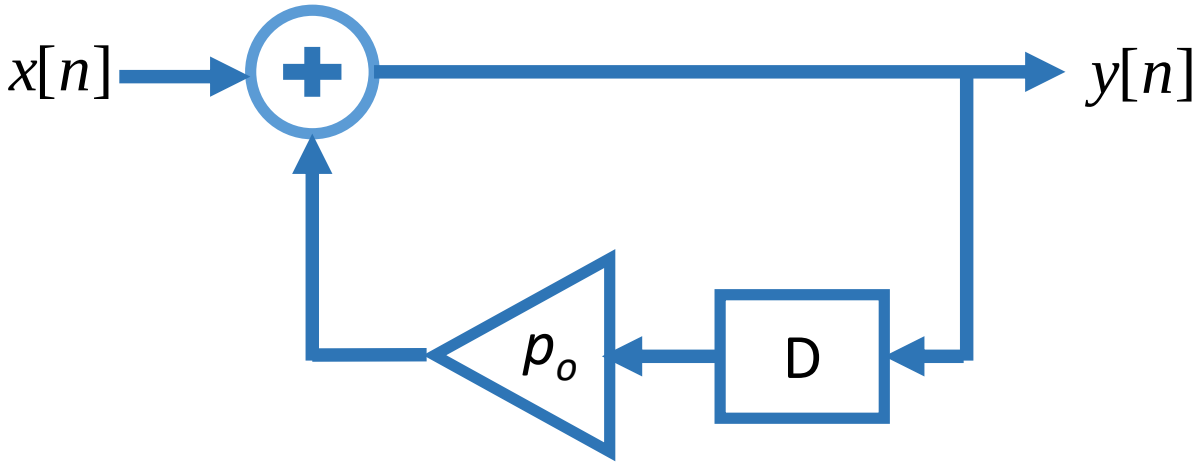
CT and DT system

Basic CT system



$$h(t) = e^{pt}u(t)$$

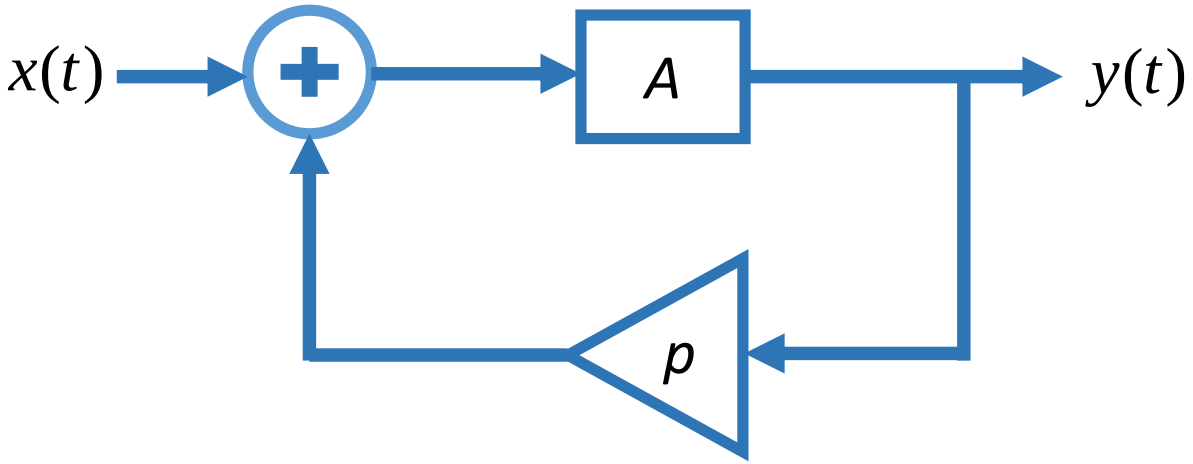
Basic DT system



$$h[n] = p_o{}^{n}u[n]$$

CT and DT system

Basic CT system



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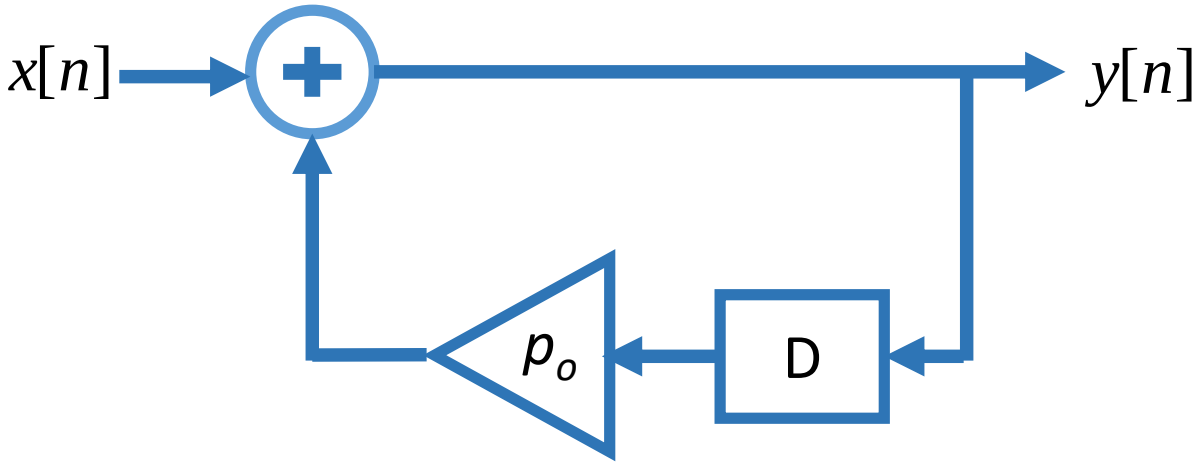
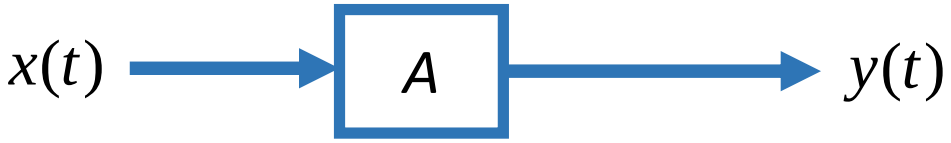
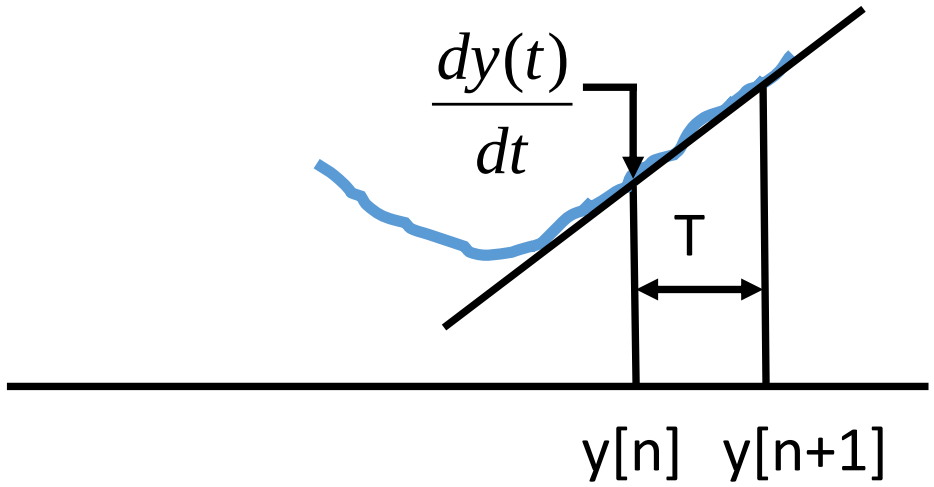


$$h[n] = p_o{}^{n}u[n]$$

Forward Euler





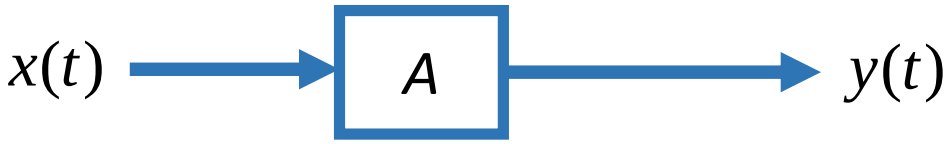
$$\frac{dy(t)}{dt} = x(t)$$

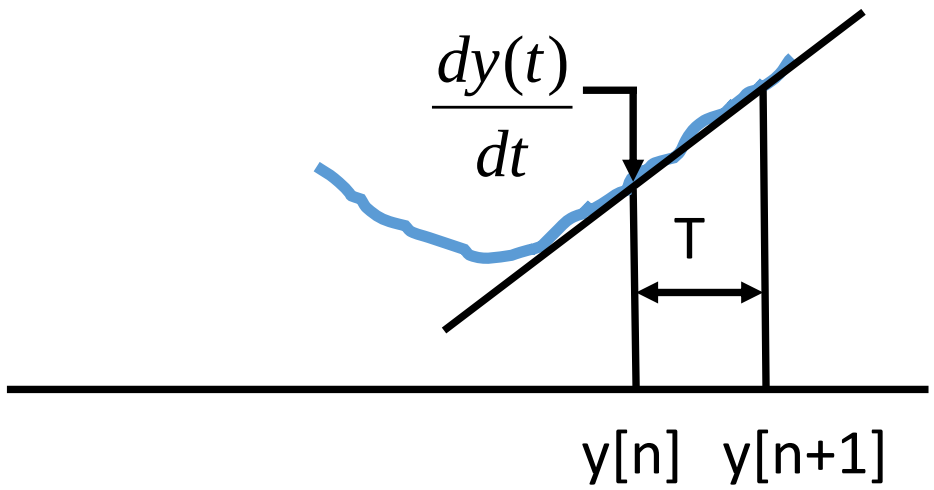
$$\frac{y[n+1]-y[n]}{T} = x[n]$$

$$sY(s) = X(s)$$

$$\frac{Y(z)z - Y(z)}{T} = X(z)$$

Forward Euler





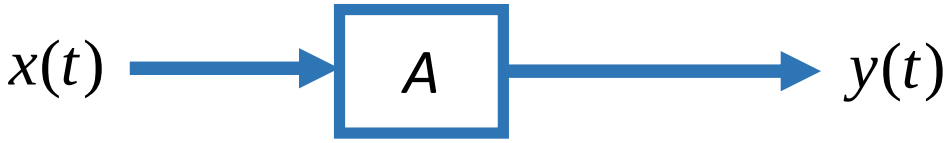
$$sY(s) = X(s)$$

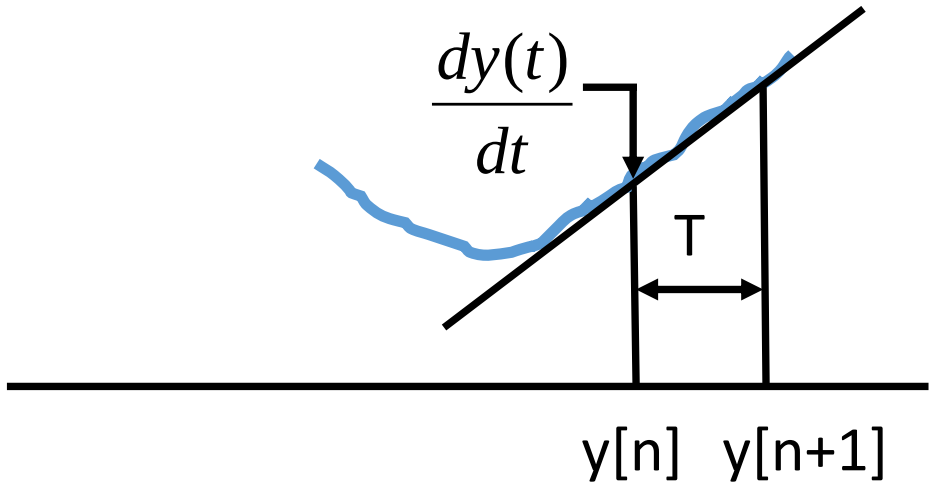
$$\frac{Y(s)}{X(s)} = \frac{1}{s}$$

$$\frac{Y(z)z - Y(z)}{T} = X(z)$$

$$\frac{Y(z)}{X(z)} = \frac{T}{z-1}$$

Forward Euler





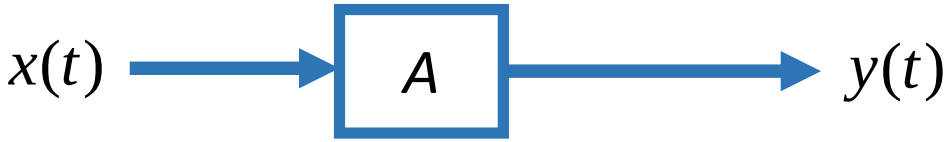
$$sY(s) = X(s)$$

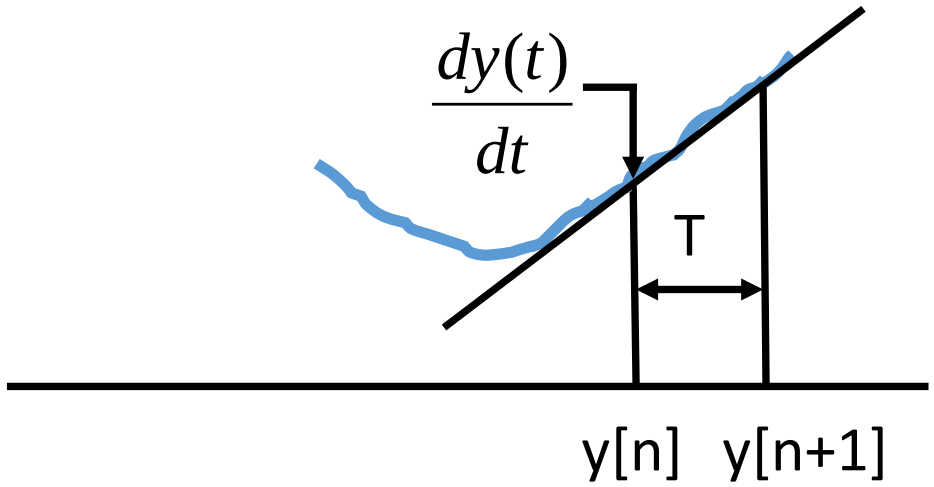
$$\frac{Y(z)z - Y(z)}{T} = X(z)$$

$$H(s) = \frac{1}{s}$$

$$H(z) = \frac{T}{z-1}$$

Forward Euler





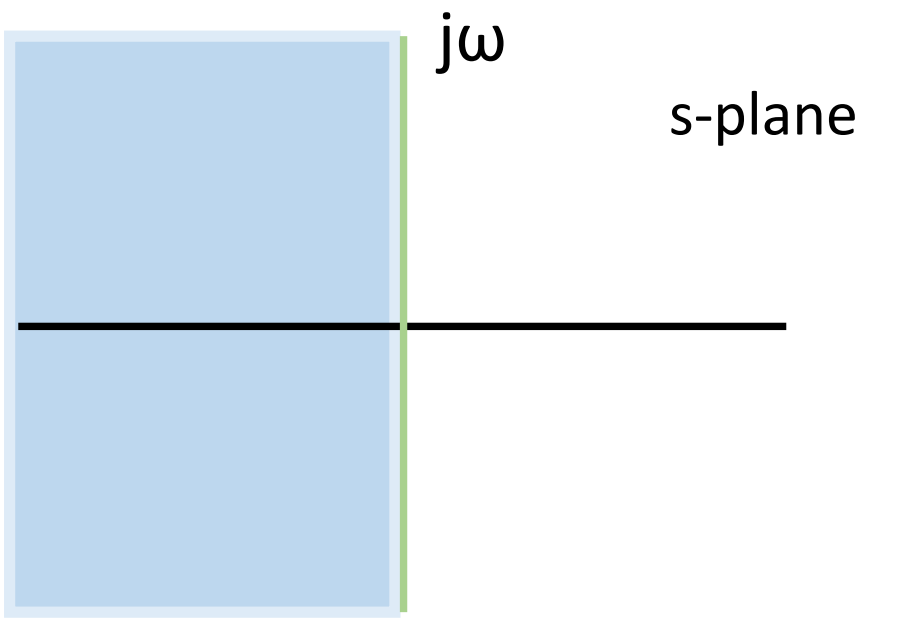
$$H(s) = \frac{1}{s}$$

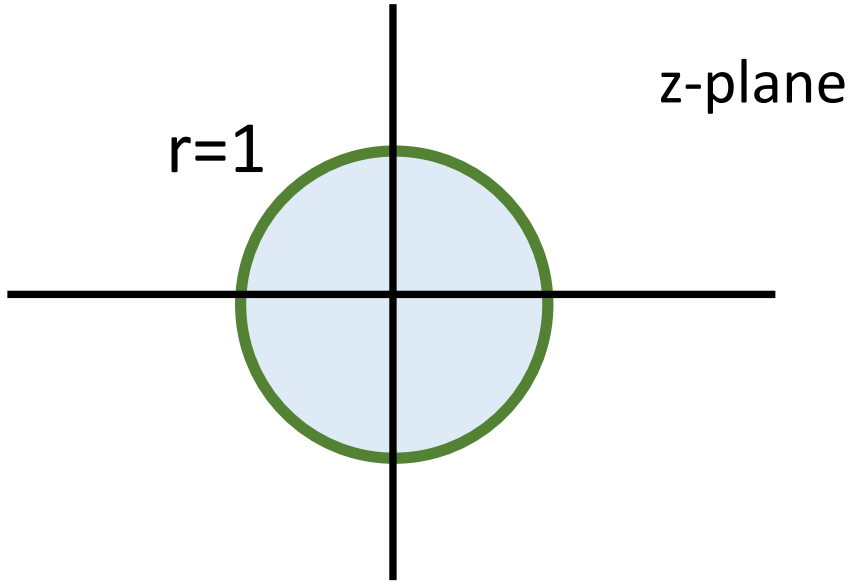
$$H(z) = \frac{T}{z-1}$$

$$H(s) = H(z) \Rightarrow \frac{1}{s} = \frac{T}{z-1}$$

Forward Euler

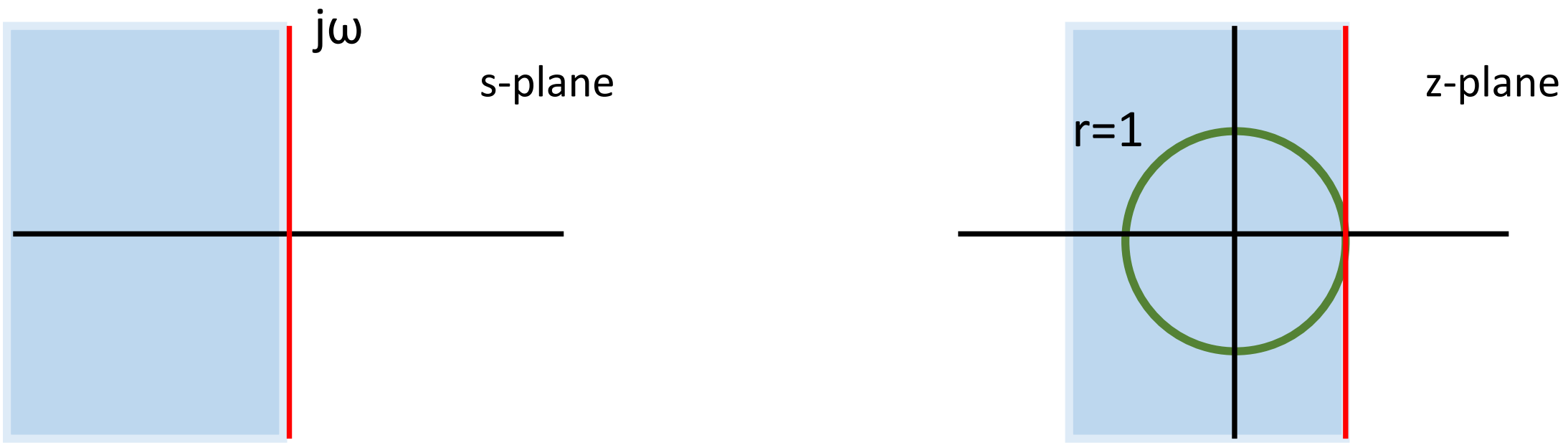
$$\frac{1}{s} = \frac{T}{z-1} \qquad z \to 1 + sT$$





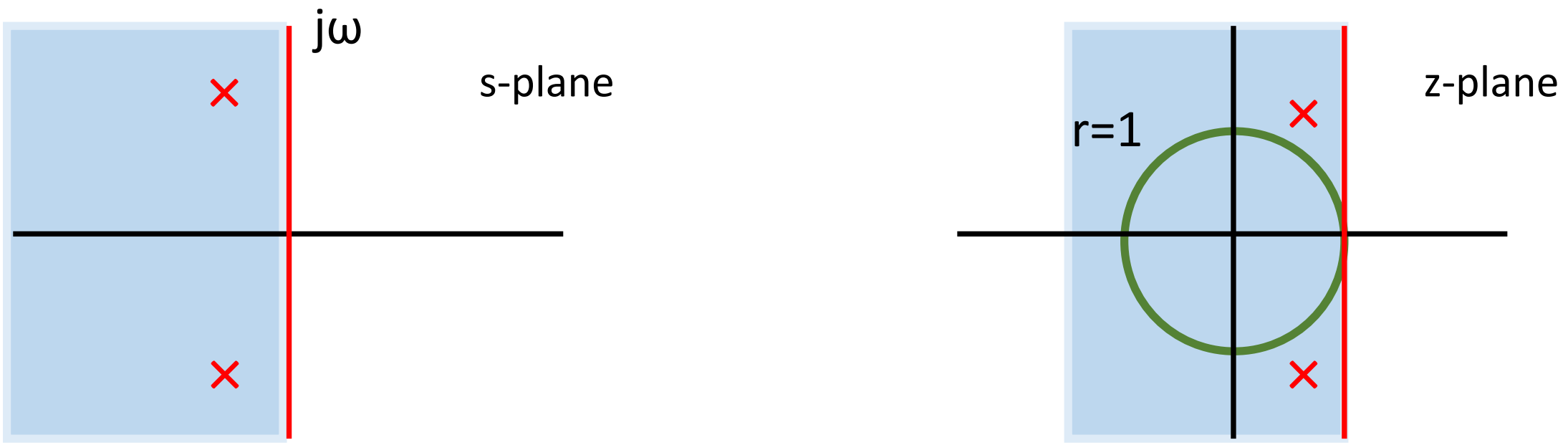
Forward Euler

$$\frac{1}{s} = \frac{T}{z-1} \qquad z \to 1 + sT$$

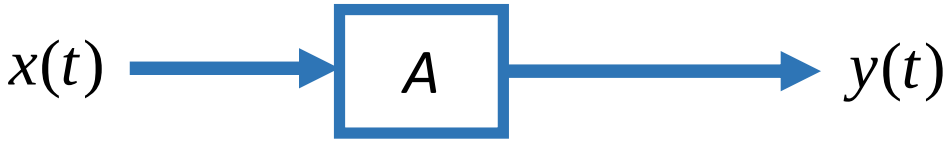


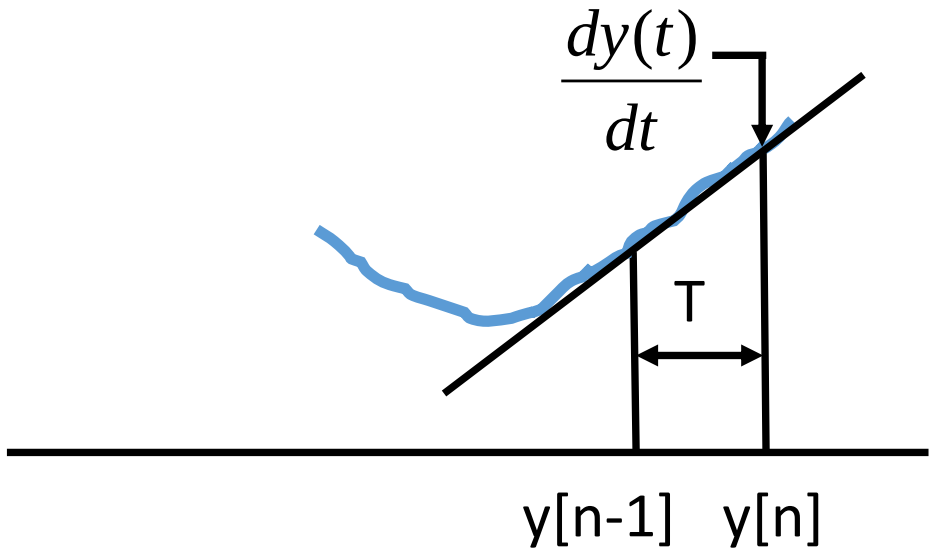
Forward Euler

$$\frac{1}{s} = \frac{T}{z-1} \qquad z \to 1 + sT$$



Backward Euler





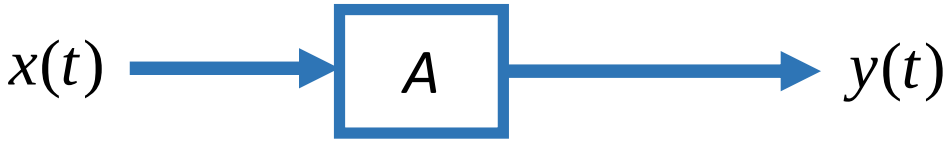
$$\frac{dy(t)}{dt} = x(t)$$

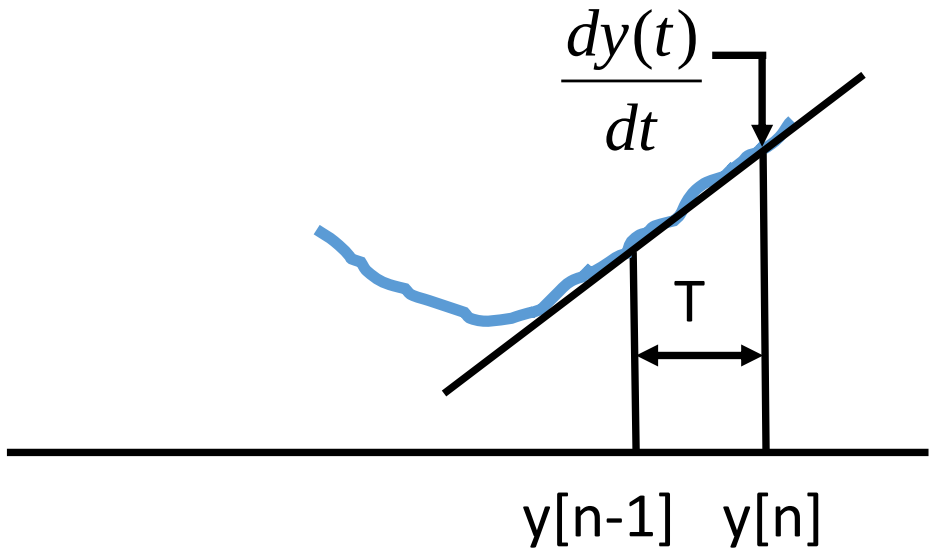
$$\frac{y[n]-y[n-1]}{T} = x[n]$$

$$sY(s) = X(s)$$

$$\frac{Y(z)-z^{-1}Y(z)}{T} = X(z)$$

Backward Euler





$$sY(s) = X(s)$$

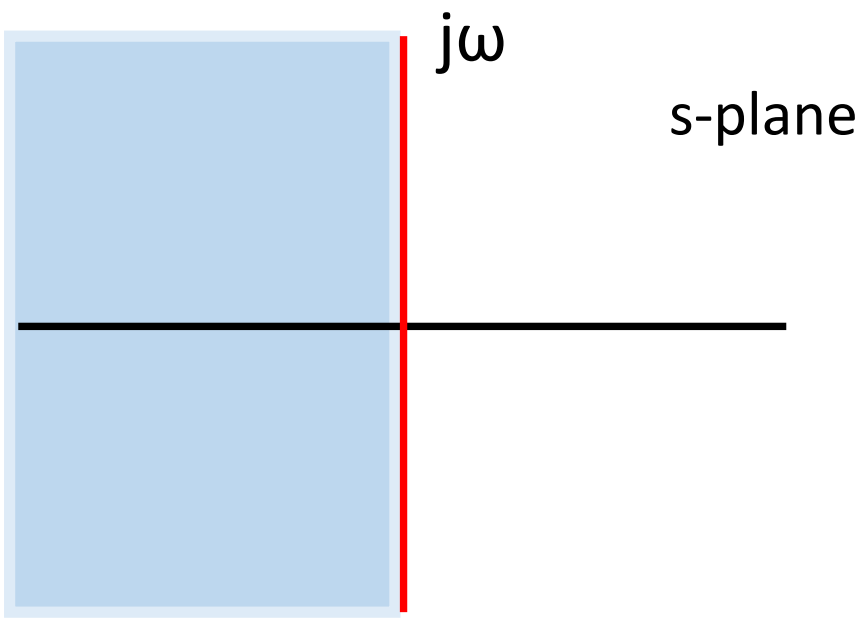
$$\frac{Y(z) - z^{-1}Y(z)}{T} = X(z)$$

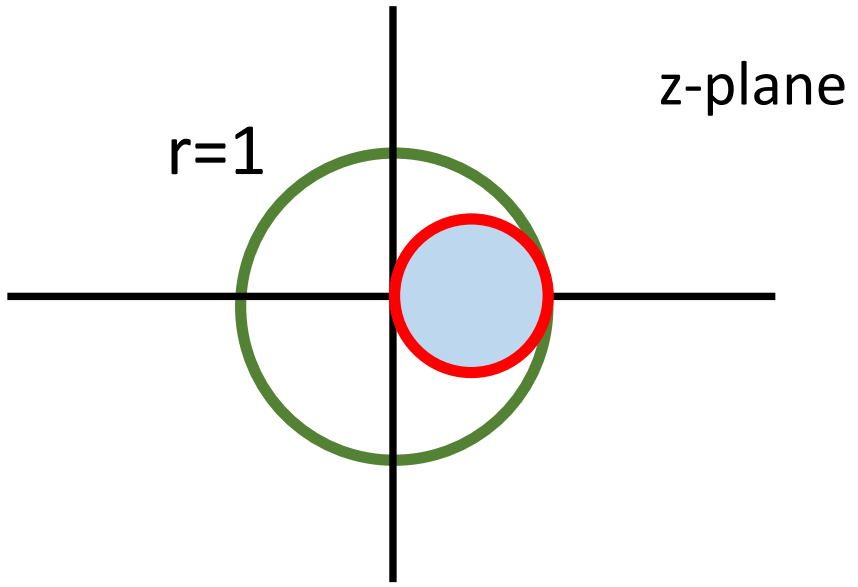
$$H(s) = \frac{1}{s}$$

$$H(z) = \frac{T}{1 - z^{-1}}$$

Backward Euler

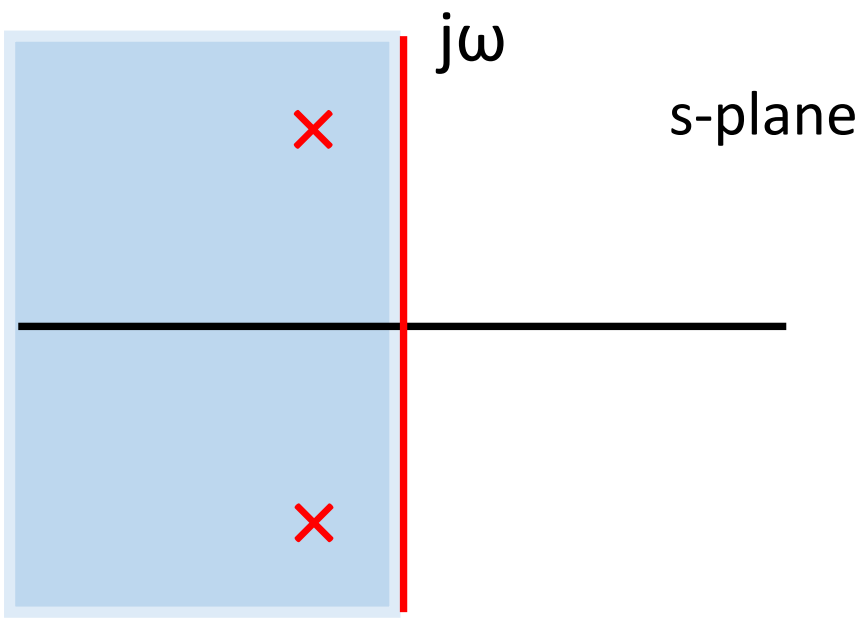
$$z \rightarrow \frac{1}{1 - sT}$$

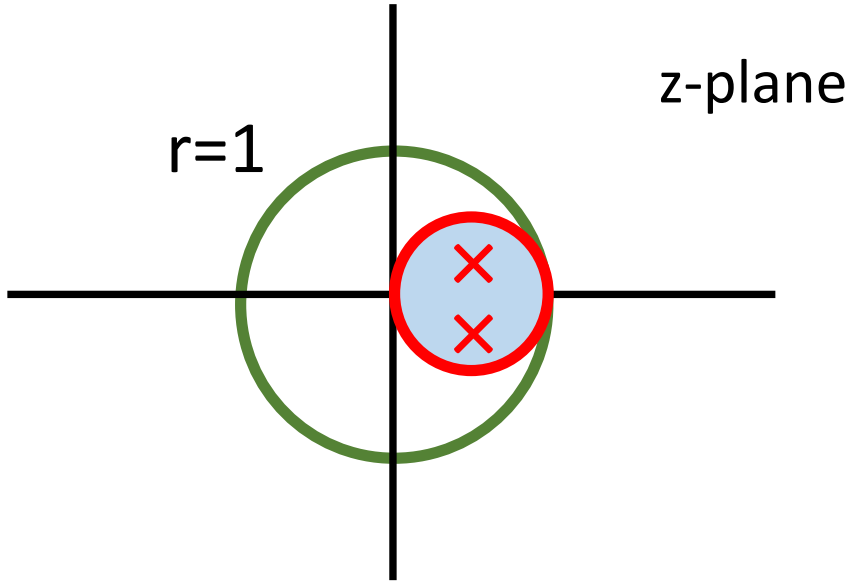




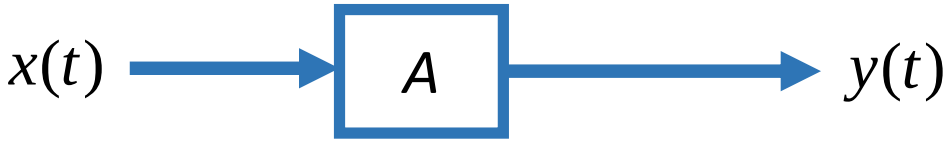
Backward Euler

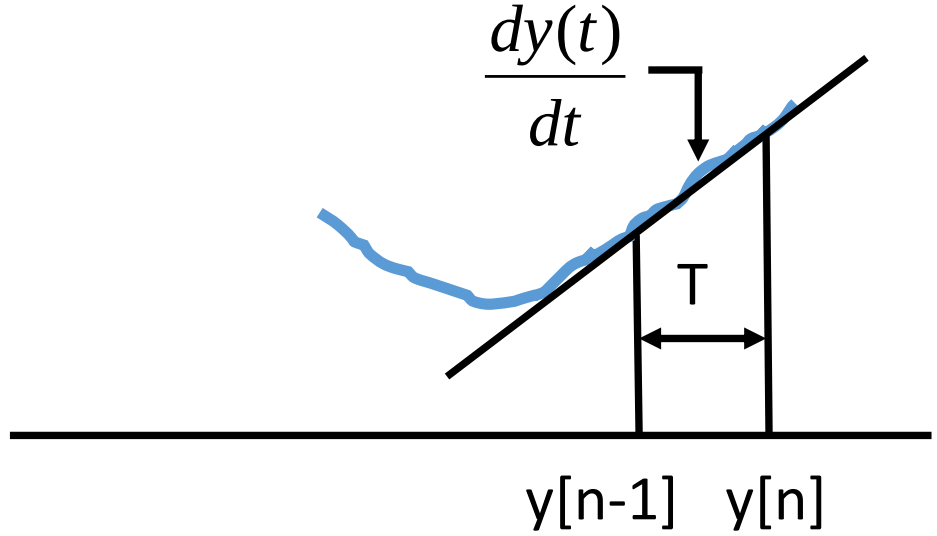
$$z \rightarrow \frac{1}{1 - sT}$$





Trapezoidal





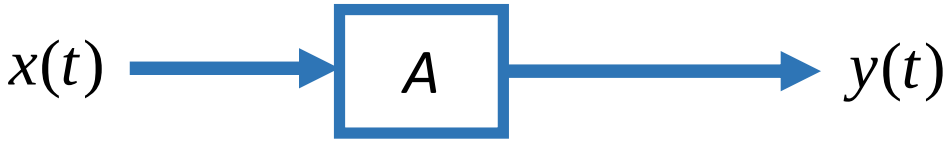
$$\frac{dy(t)}{dt} = x(t)$$

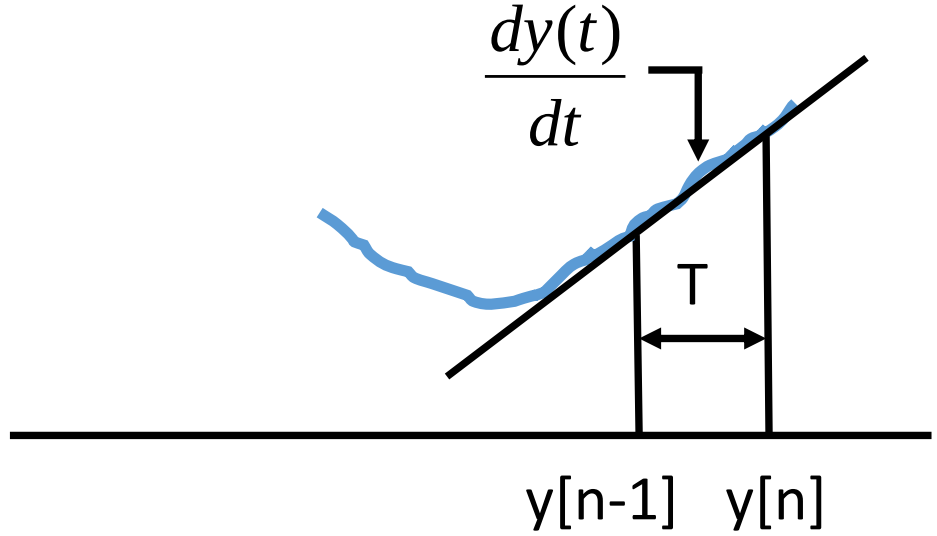
$$sY(s) = X(s)$$

$$\frac{y[n] - y[n-1]}{T} = \frac{x[n] + x[n-1]}{2}$$

$$\frac{Y(z) - z^{-1}Y(z)}{T} = \frac{X(z) + z^{-1}X(z)}{2}$$

Trapezoidal





$$sY(s) = X(s)$$

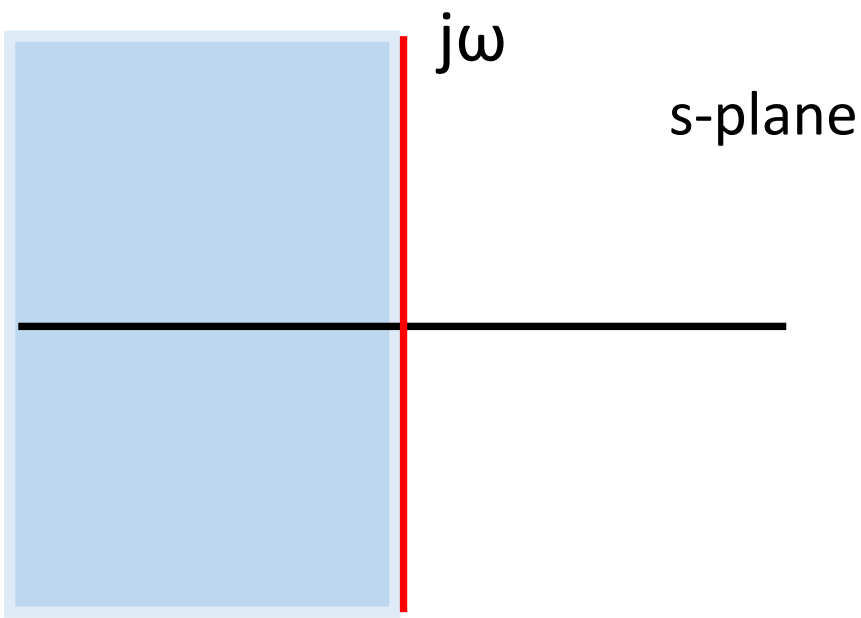
$$\frac{Y(z) - z^{-1}Y(z)}{T} = \frac{X(z) + z^{-1}X(z)}{2}$$

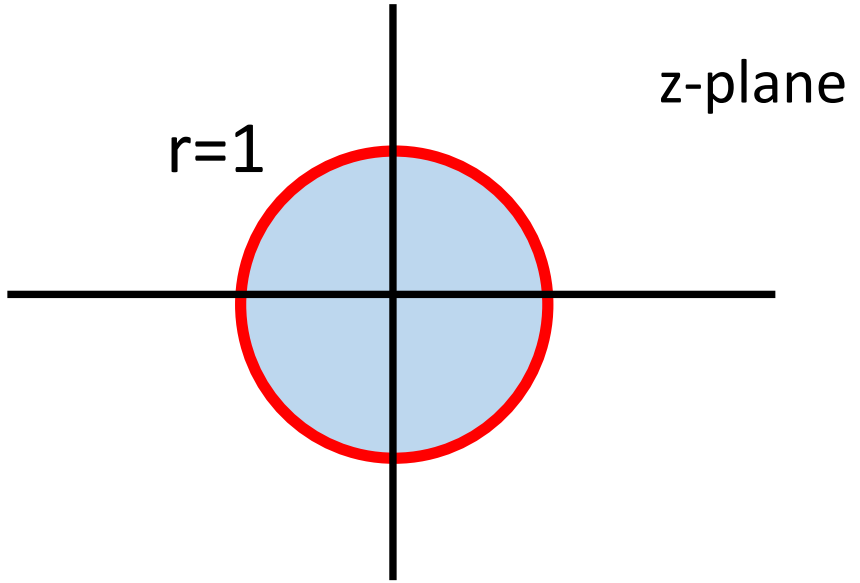
$$H(s) = \frac{1}{s}$$

$$H(z) = \frac{T(1+z^{-1})}{2(1-z^{-1})}$$

Trapezoidal

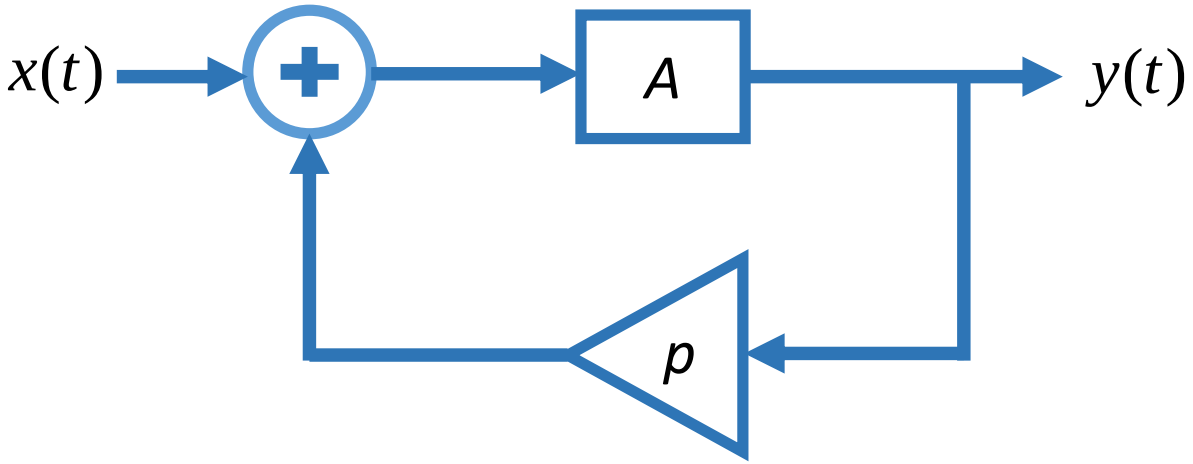
$$z \rightarrow \frac{1+\frac{sT}{2}}{1-\frac{sT}{2}}$$





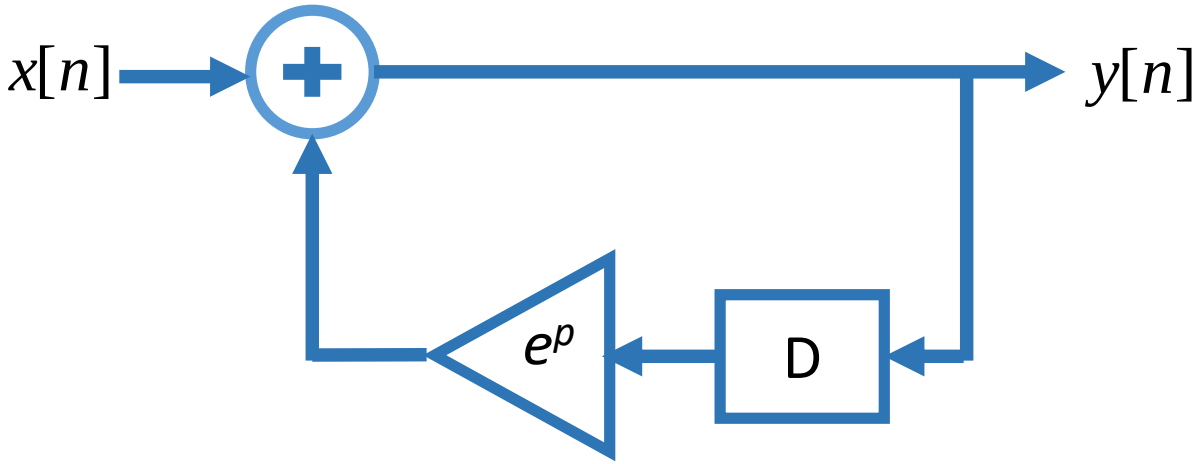
Impulse-invariance

Basic CT system



$$h(t) = e^{pt}u(t)$$

Basic DT system

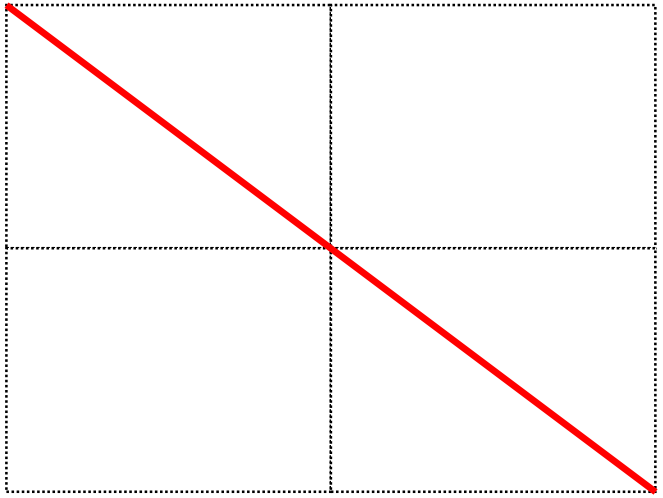


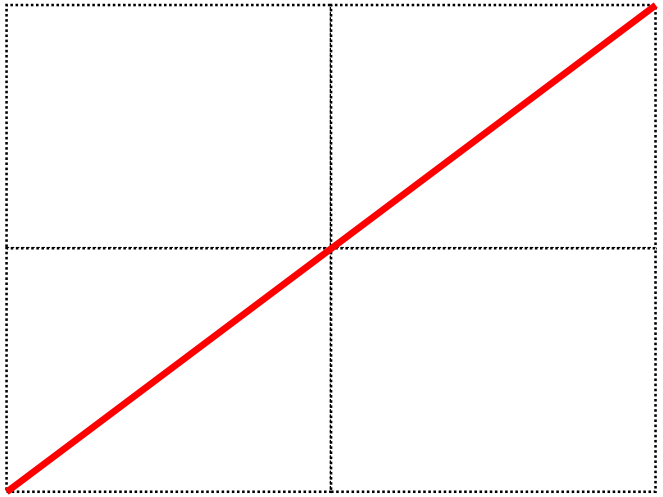
$$h[n] = p_o{}^n u[n] = e^{pn}u[n]$$

Applications of the course

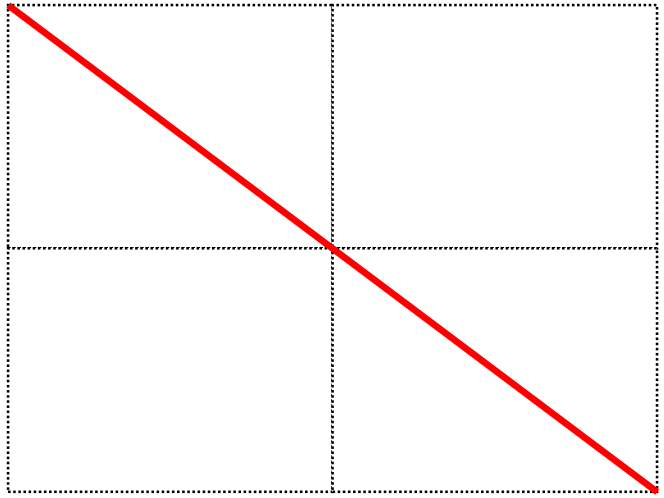
1. Speech synthesis
2. *Convolution neural networks*
3. Health applications
4. Optics and Spatial filtering
5. And some more

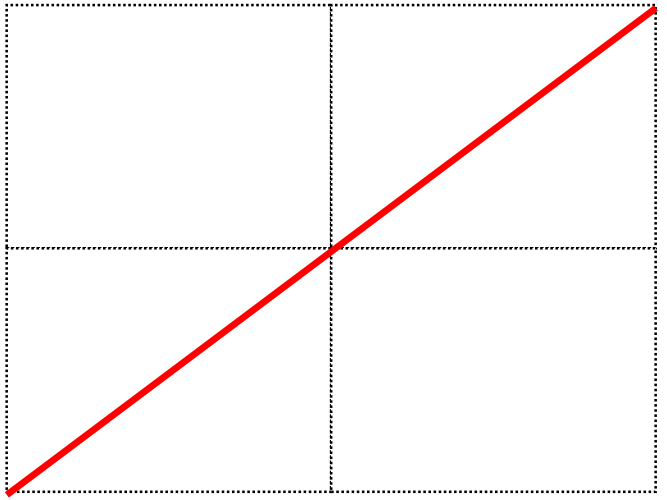
Teach intelligence to Computers





Teach intelligence to Computers

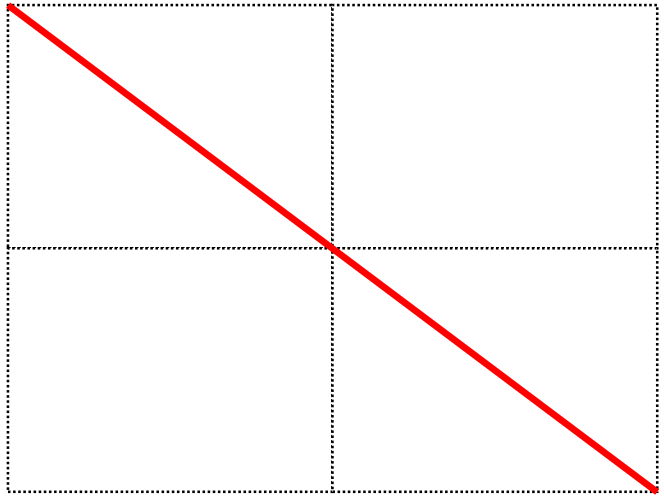




1	-1
-1	1

-1	1
1	-1

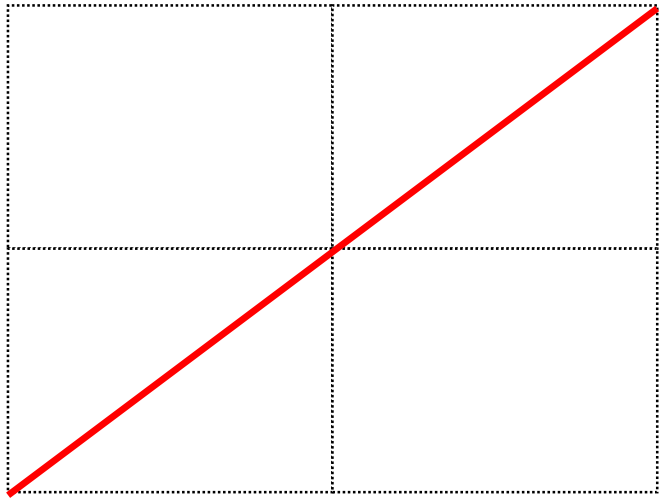
Teach intelligence to Computers



1	-1
-1	1

1	-1	-1	1

\+ + + = 0

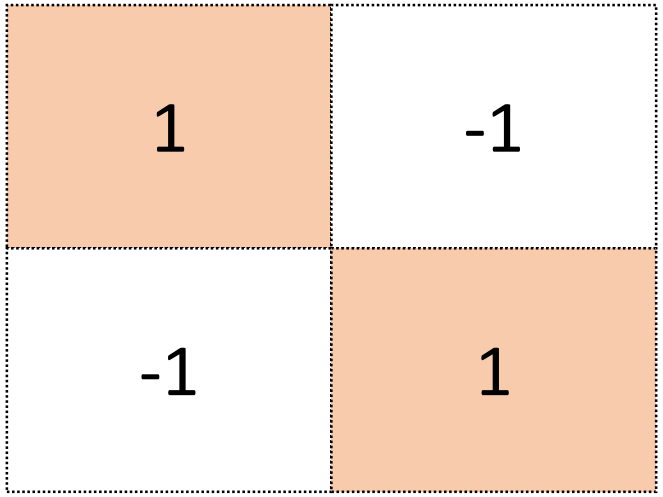


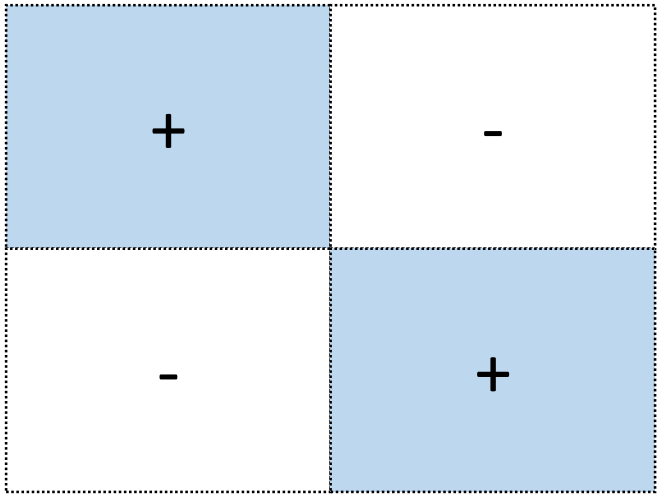
-1	1
1	-1

-1	1	1	-1

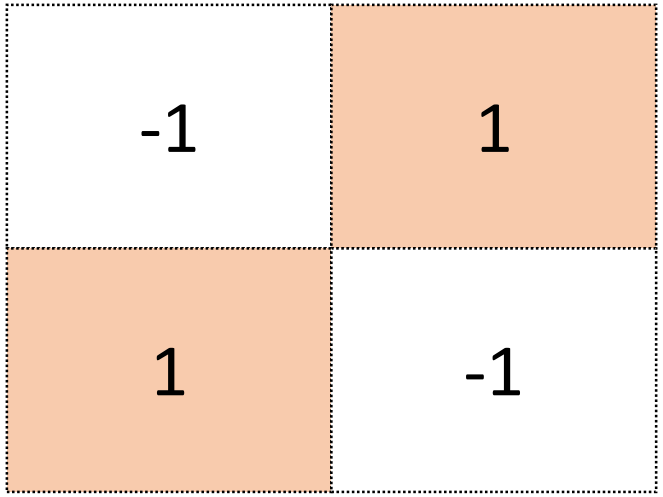
\+ + + = 0

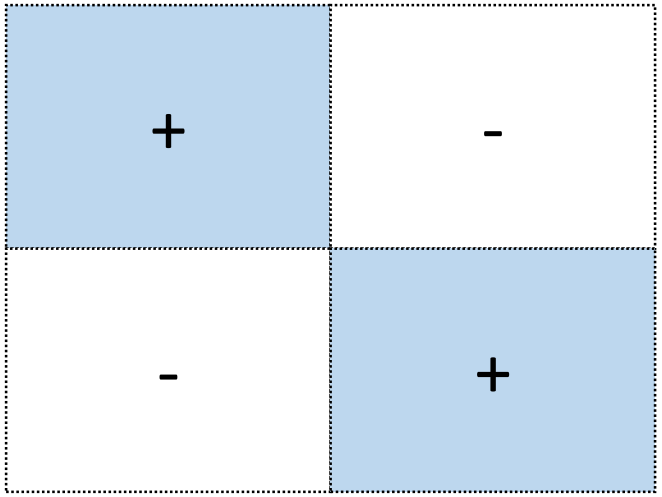
Teach intelligence to Computers





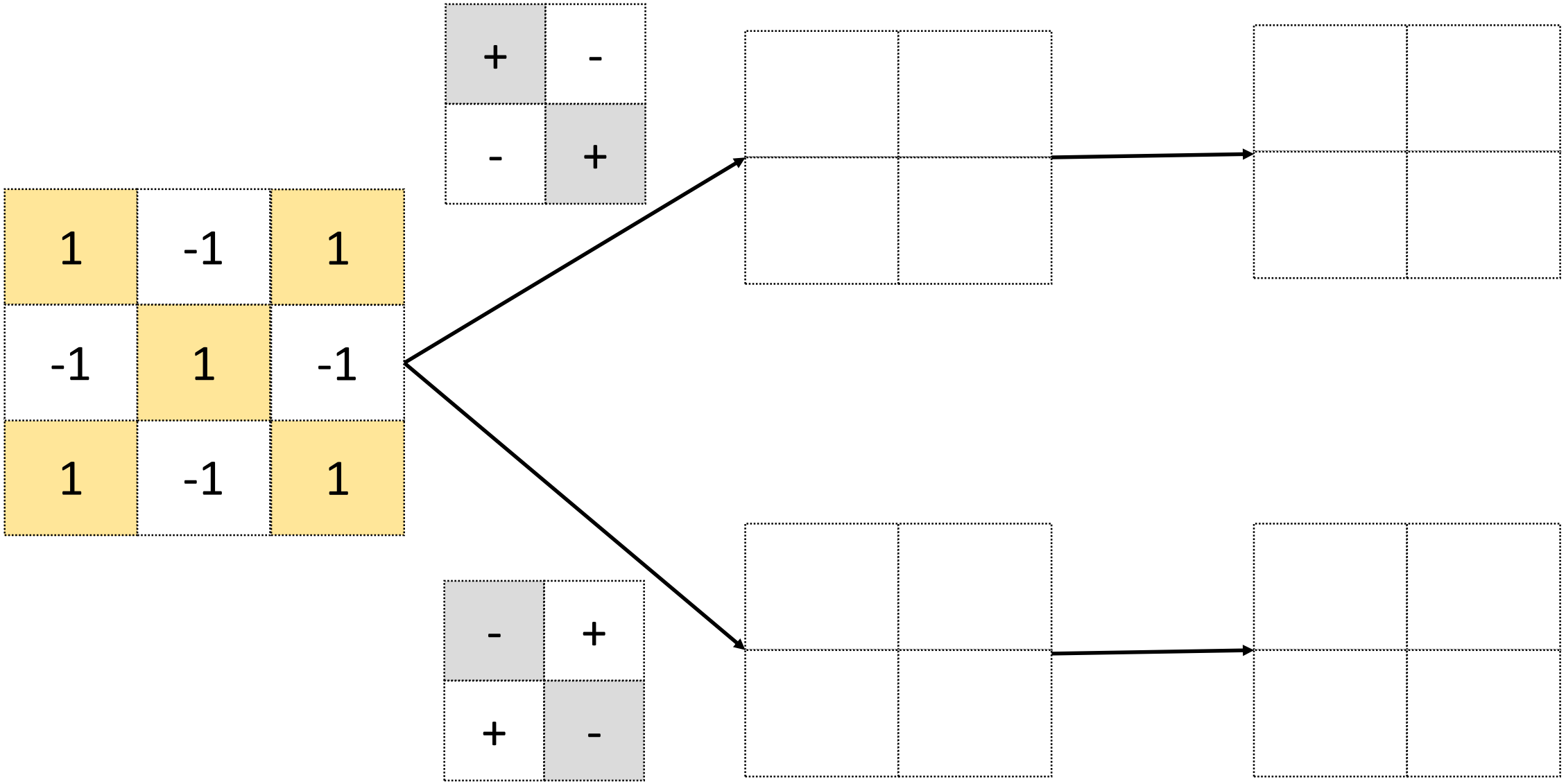
1	-1	-1	1
+	-	-	+ = 4



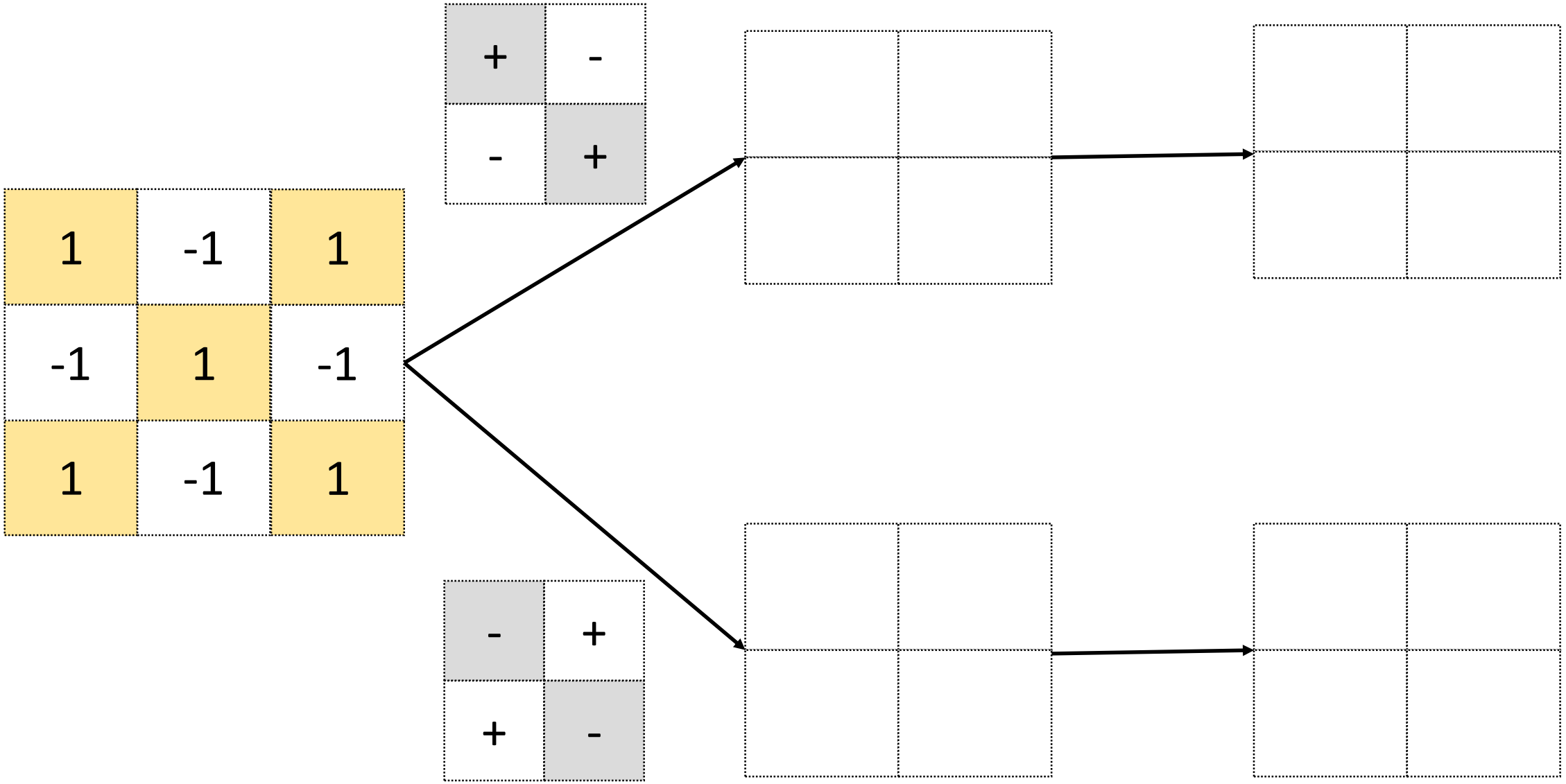


-1	1	1	-1
+	-	-	+ = -4

Teach intelligence to Computers



Teach intelligence to Computers



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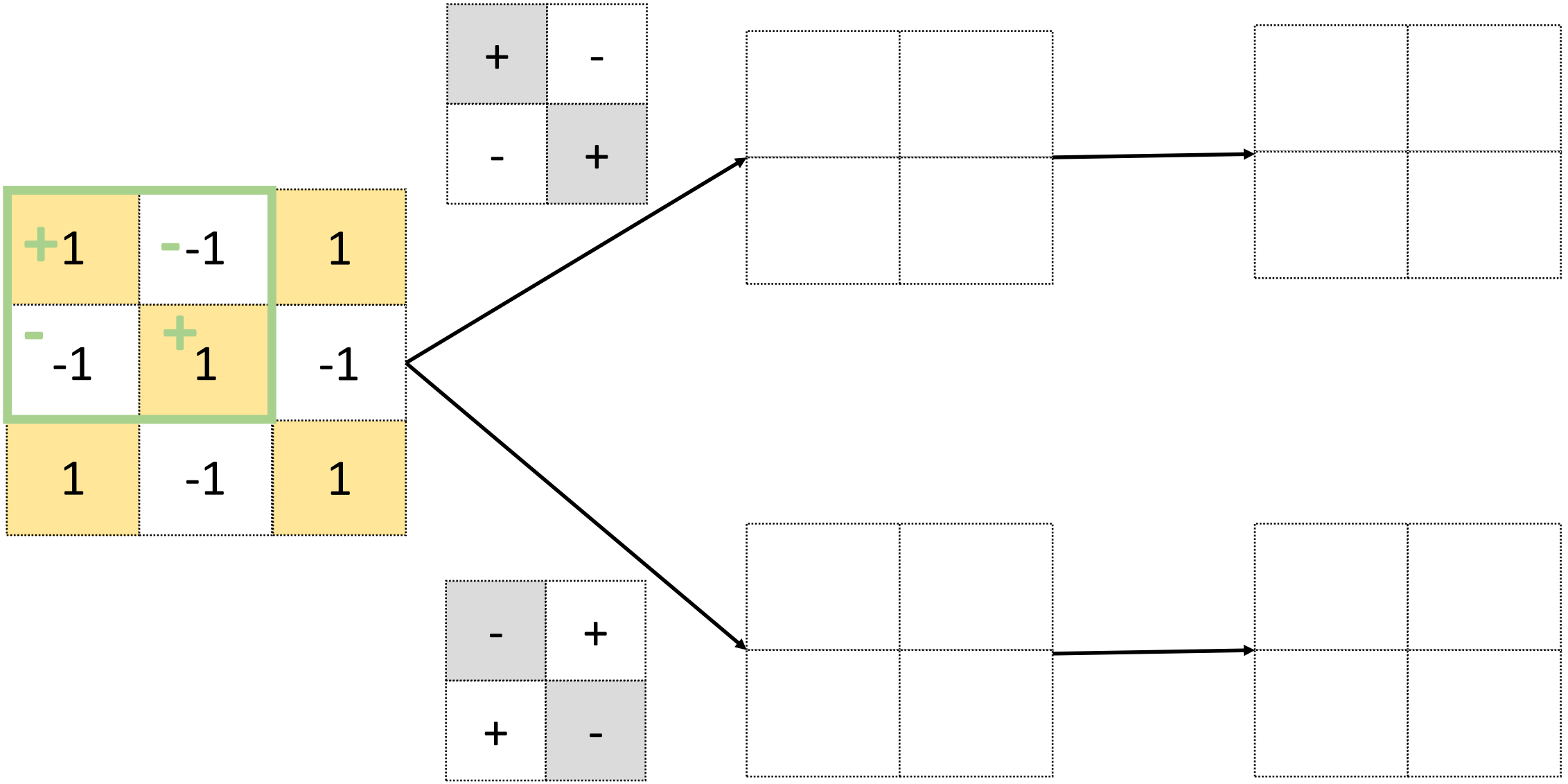
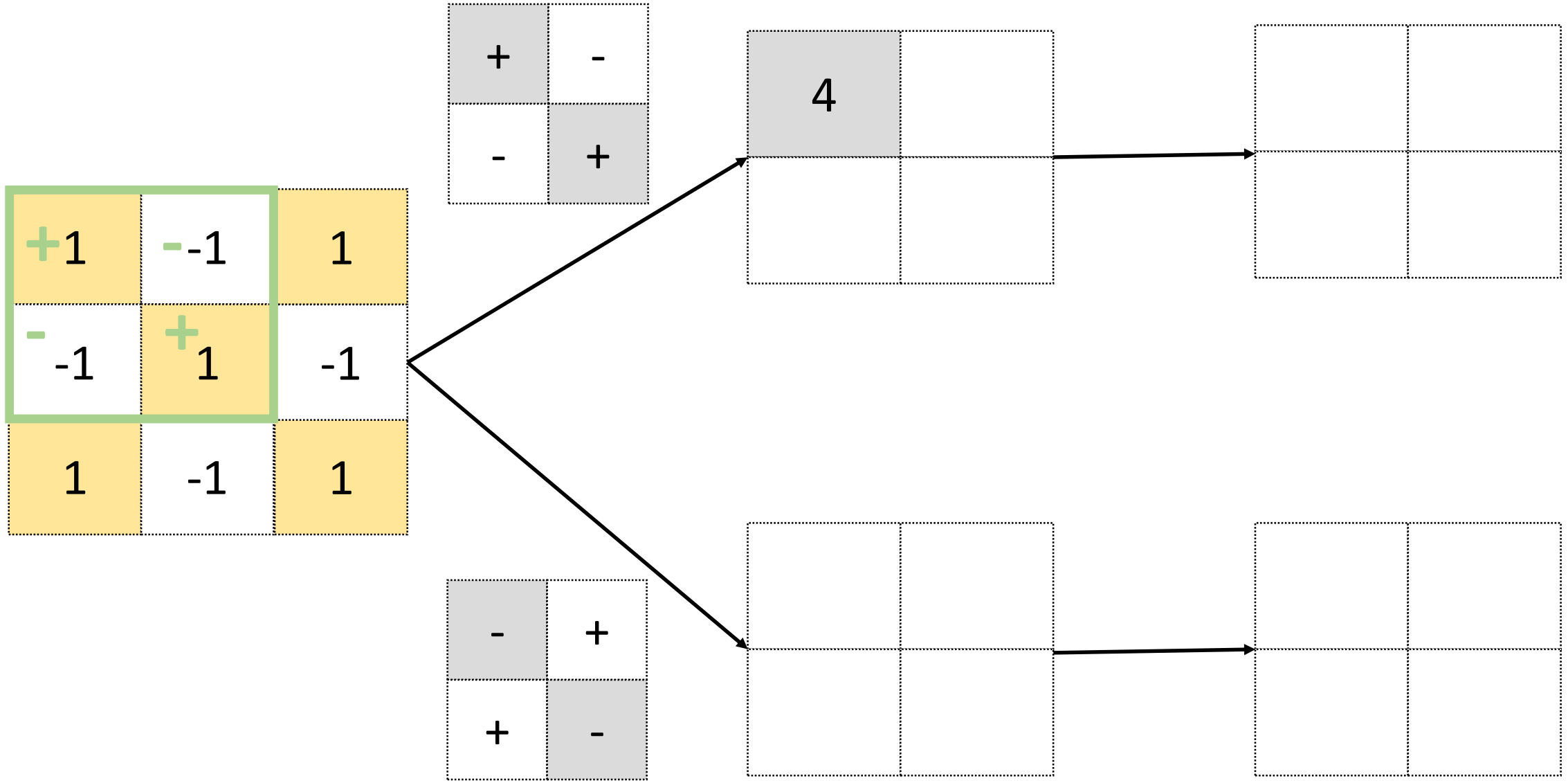
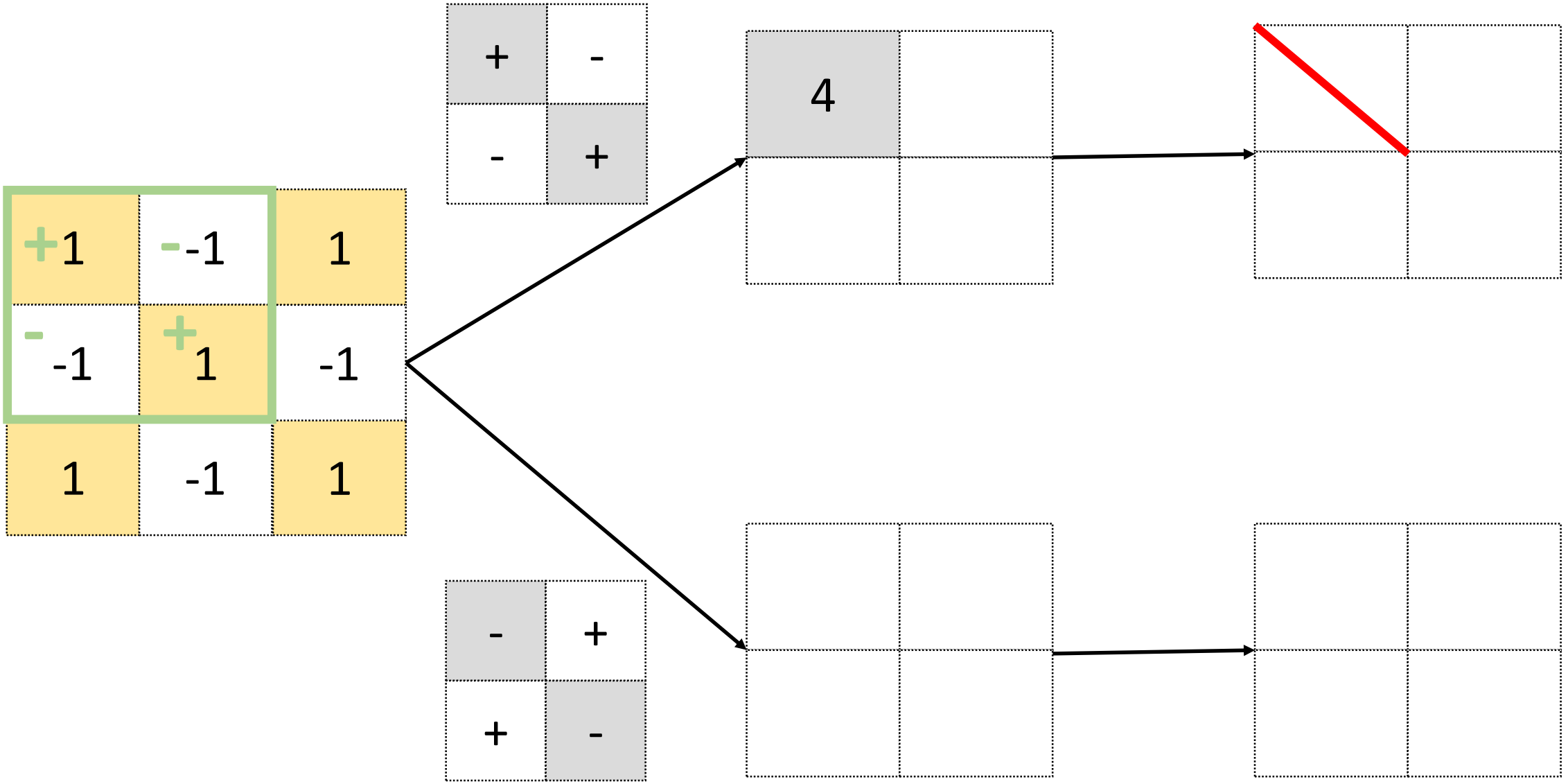


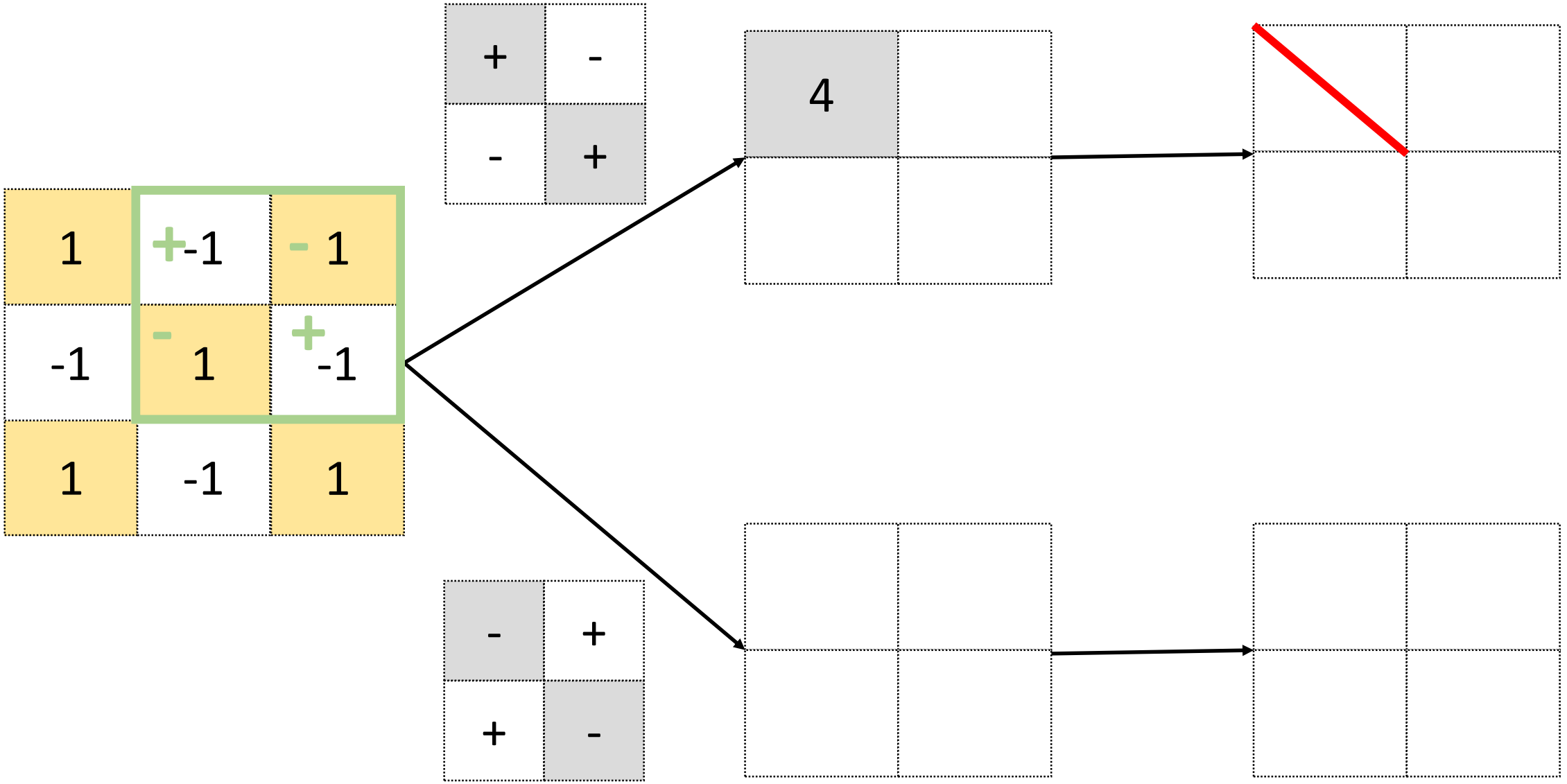
Teach intelligence to Computers



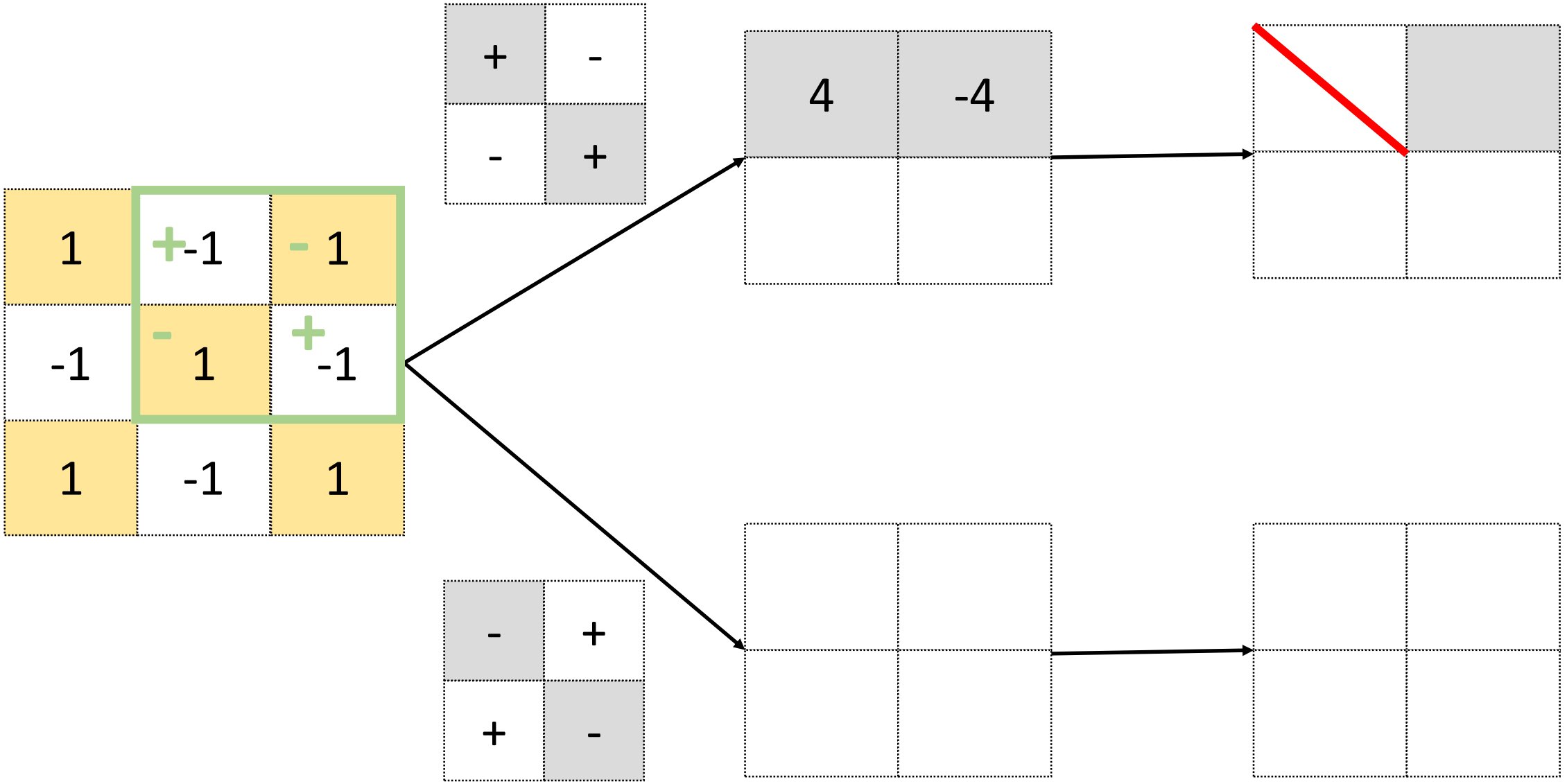
Teach intelligence to Computers



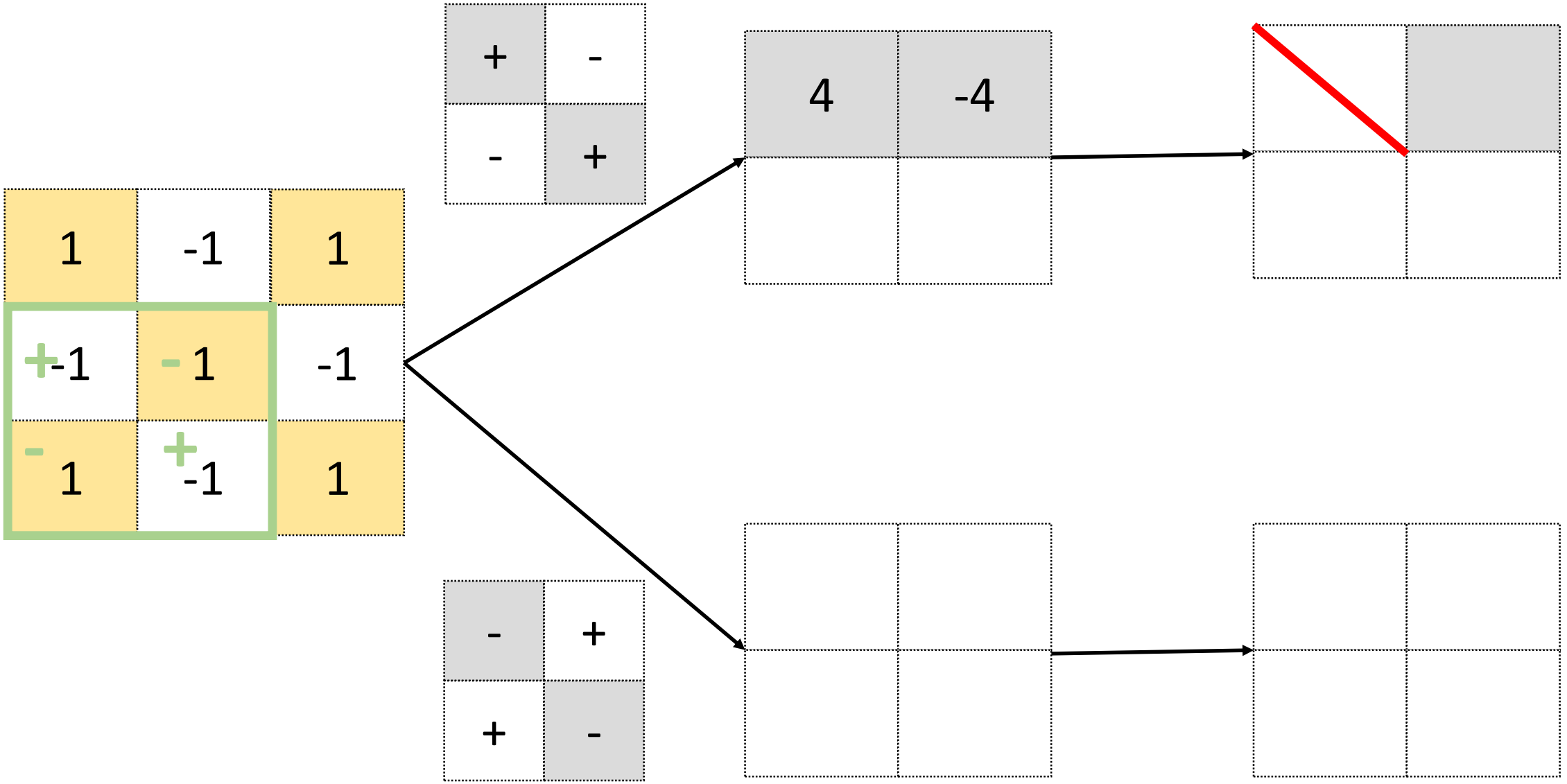
Teach intelligence to Computers



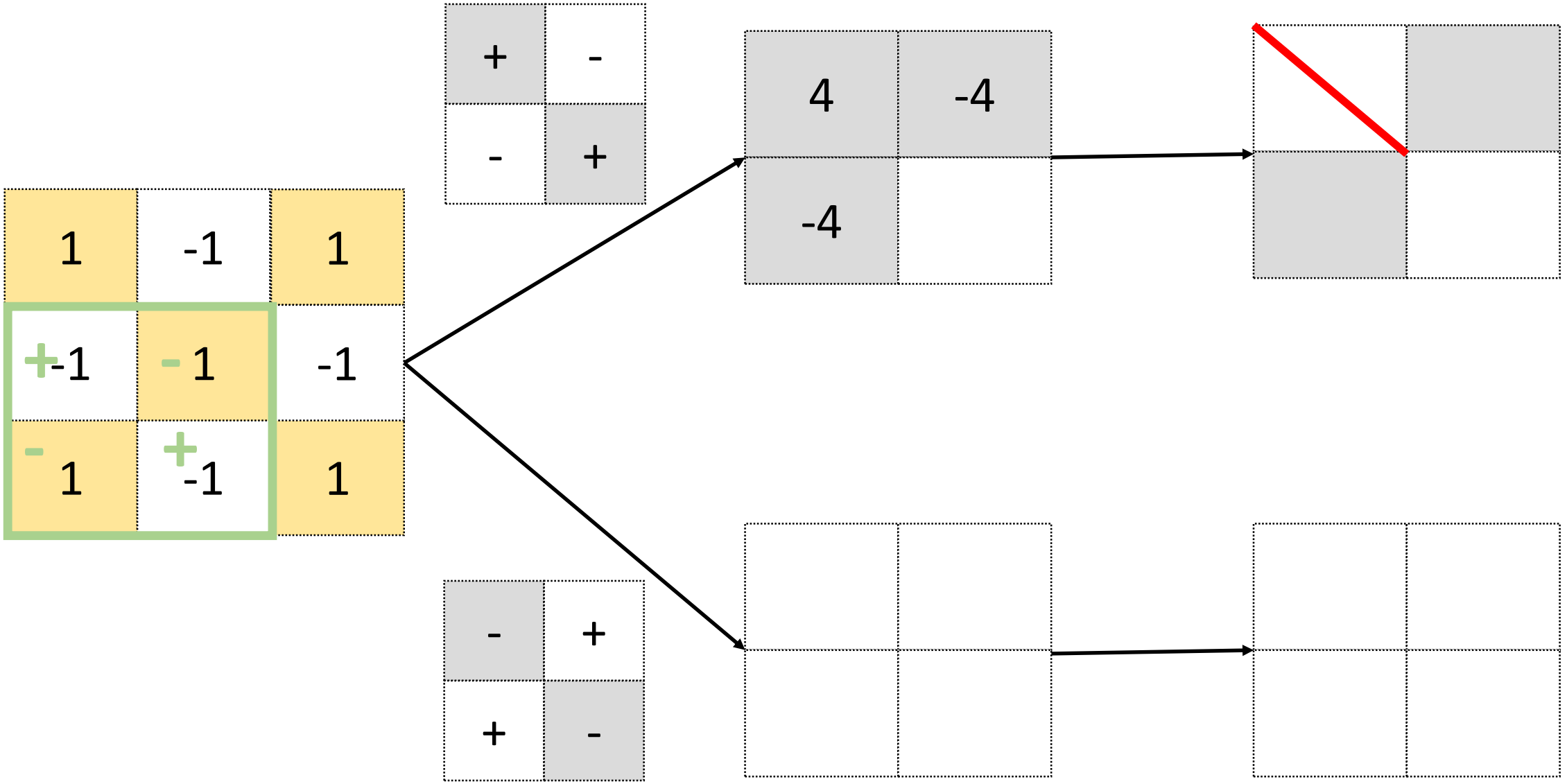
Teach intelligence to Computers



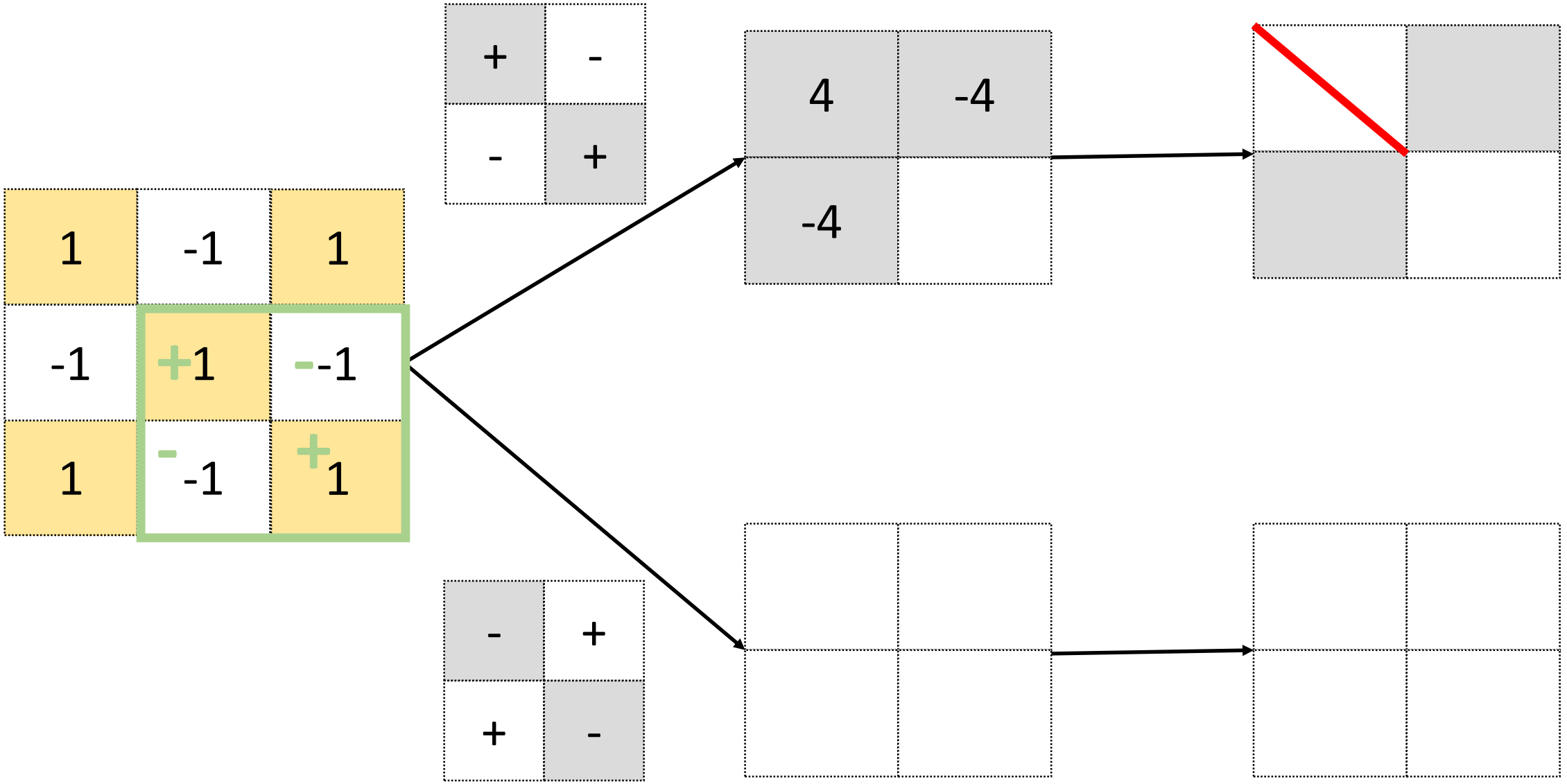
Teach intelligence to Computers



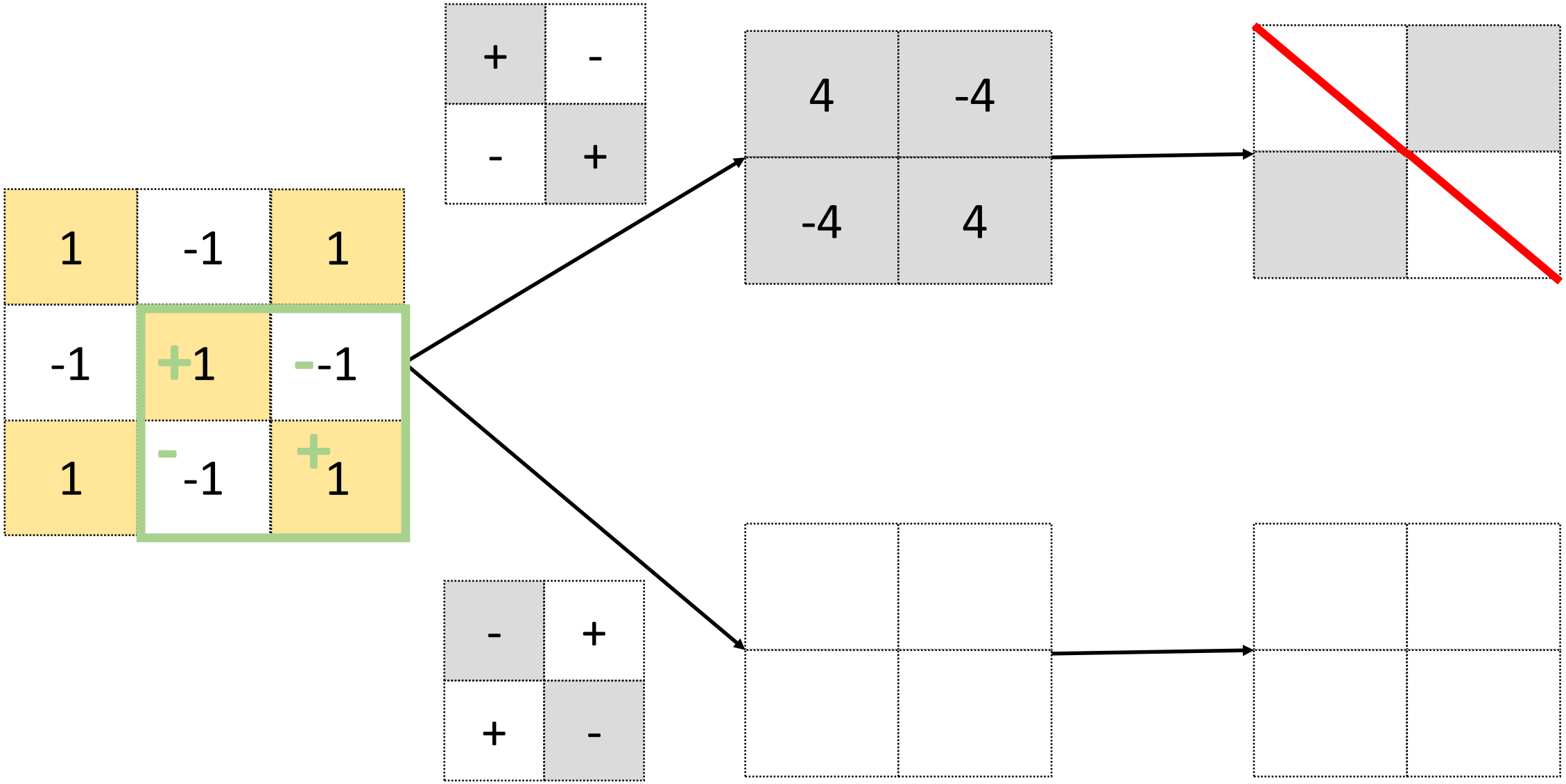
Teach intelligence to Computers



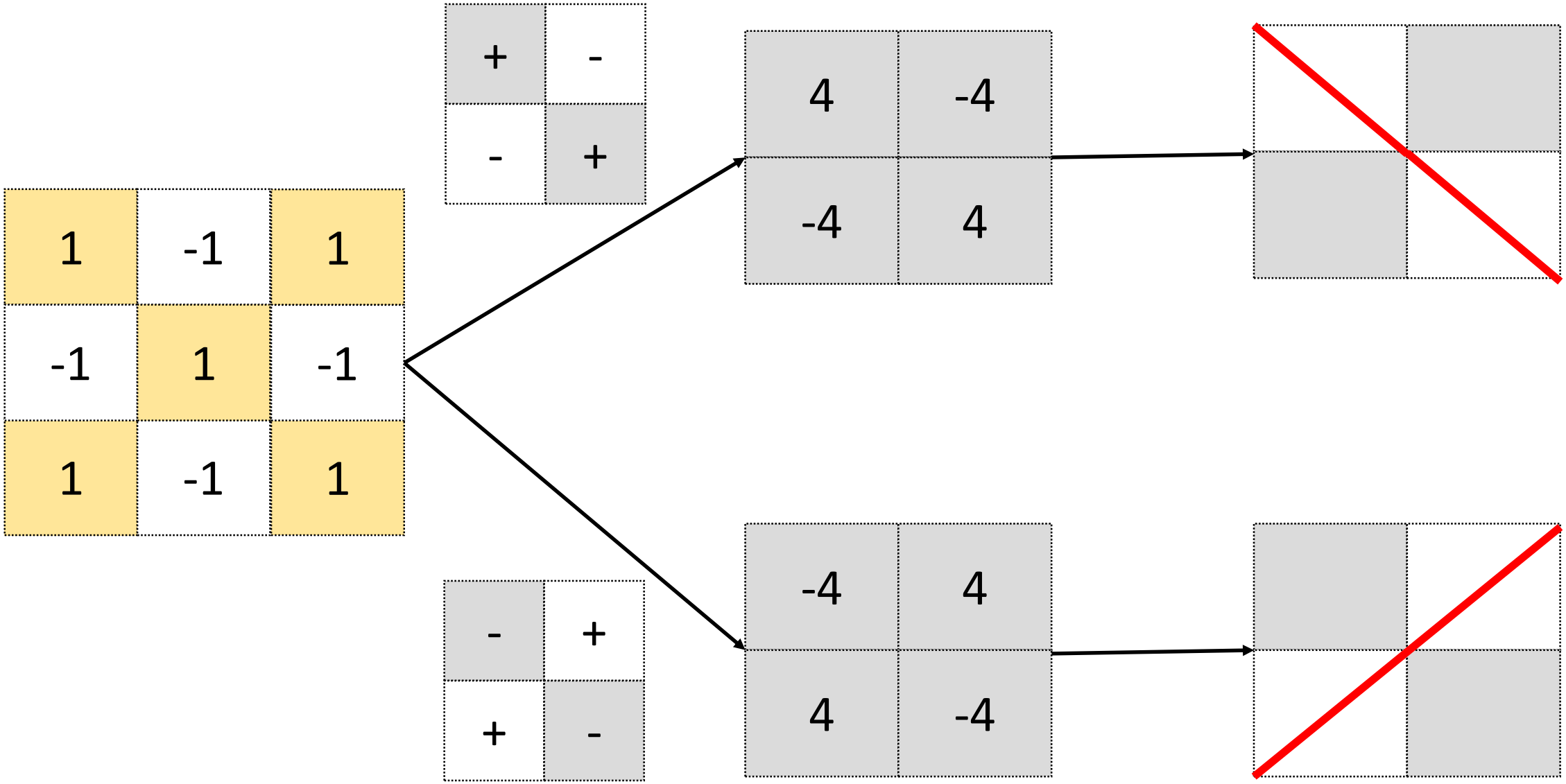
Teach intelligence to Computers



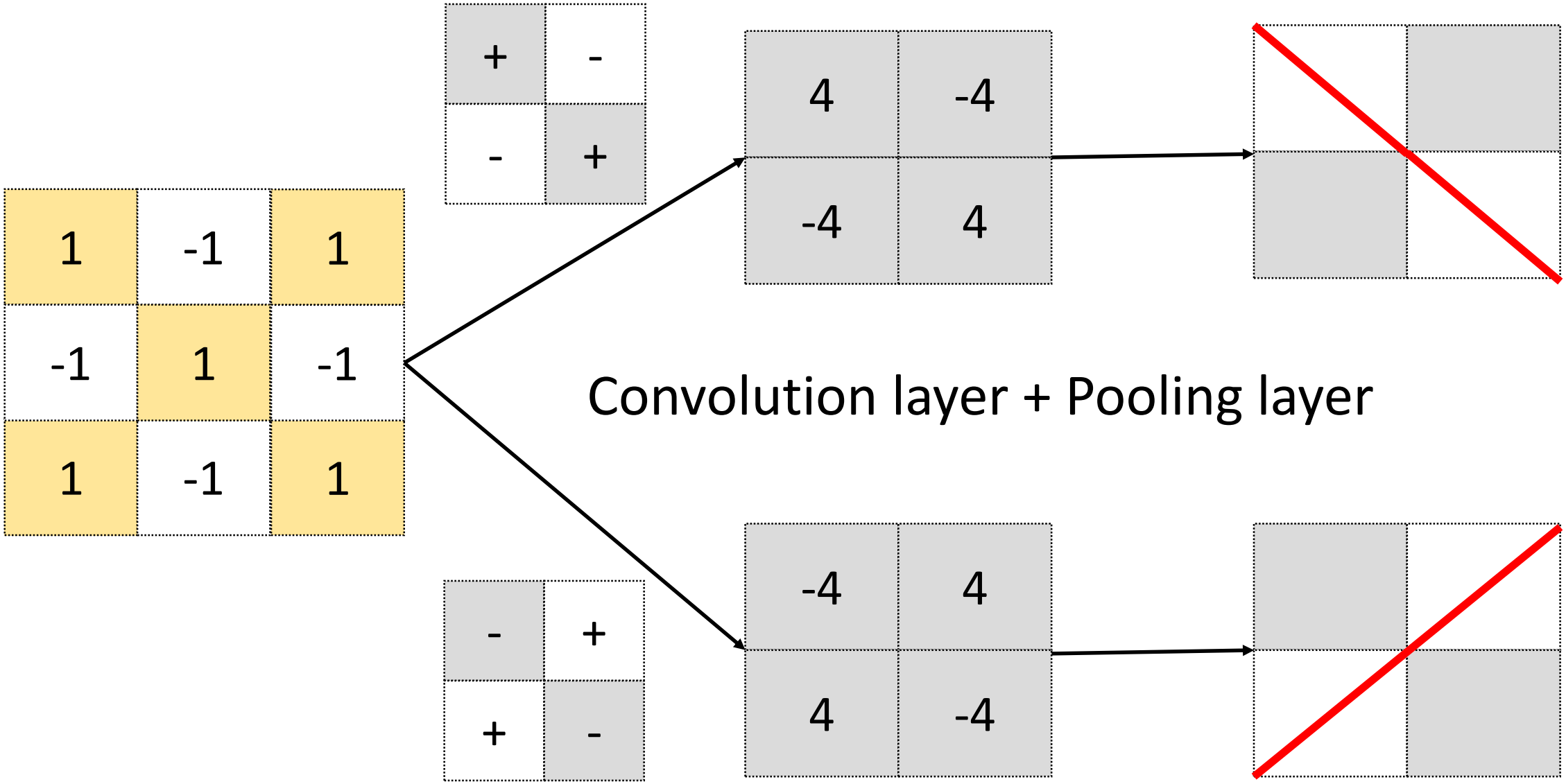
Teach intelligence to Computers



Teach intelligence to Computers



Teach intelligence to Computers



Applications of the course

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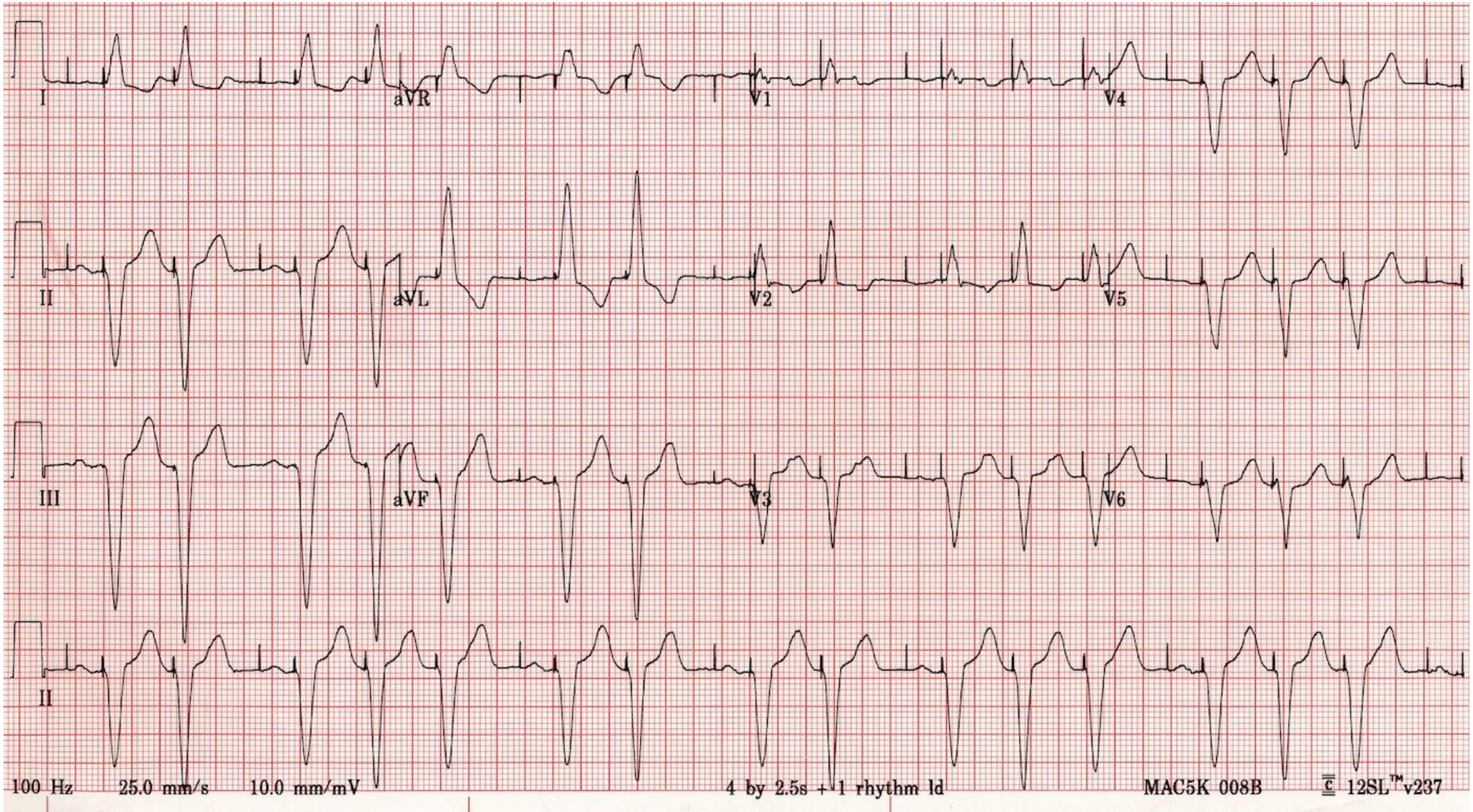
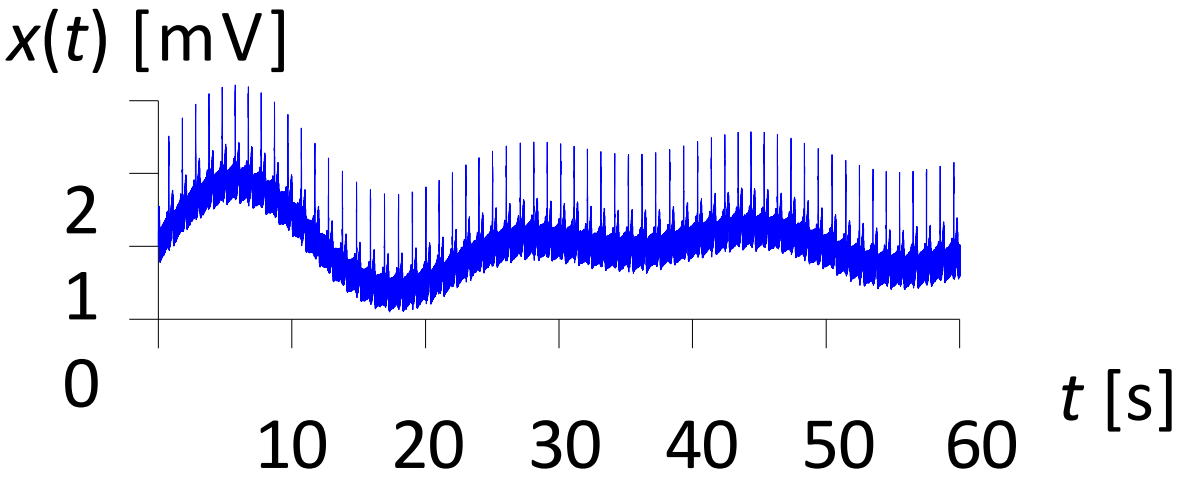
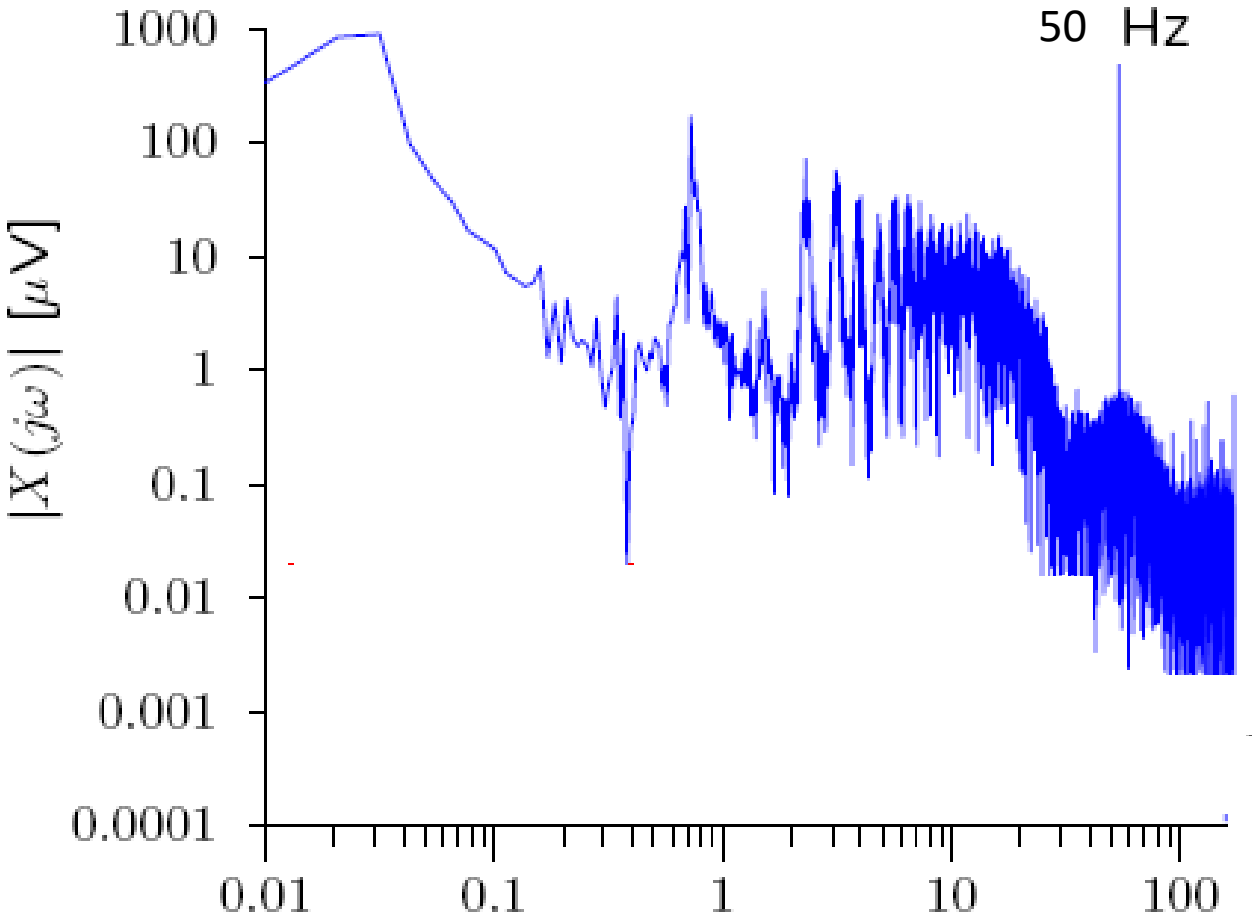
Electrocardiogram

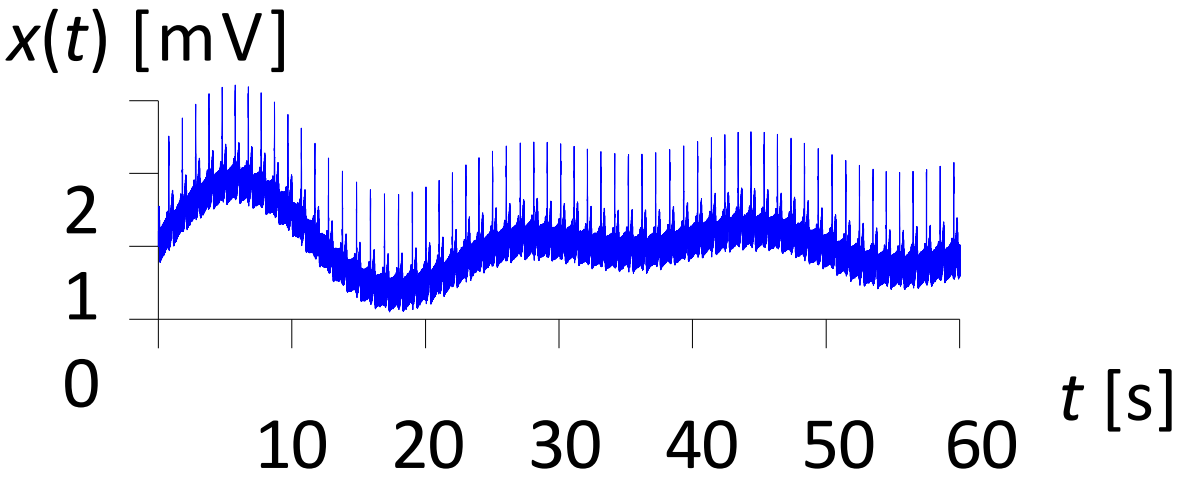


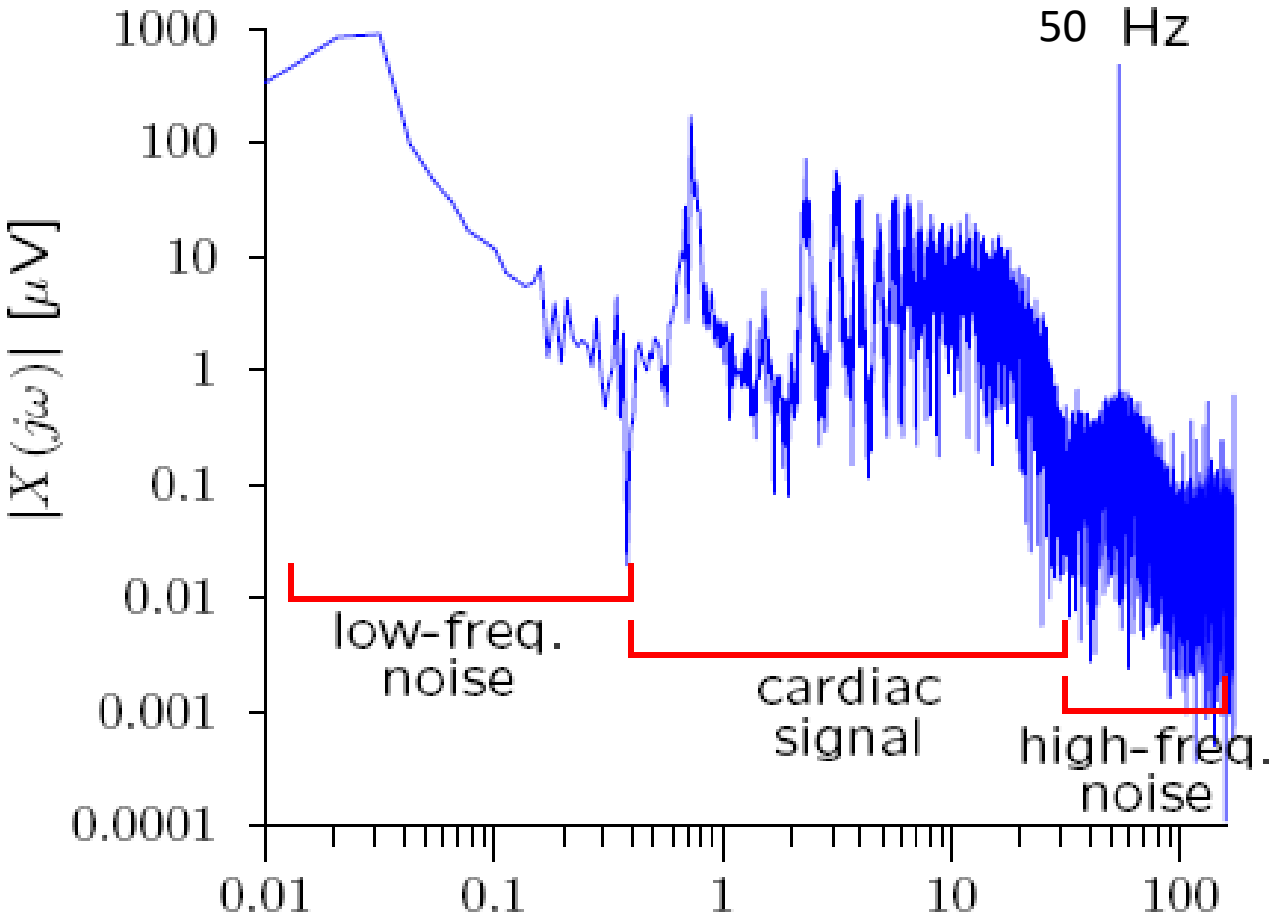
Electrocardiogram





Electrocardiogram





Applications of the course

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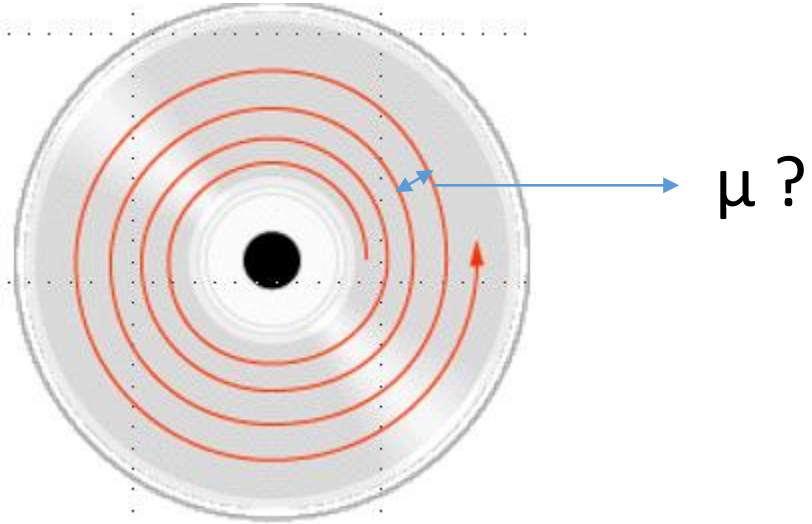
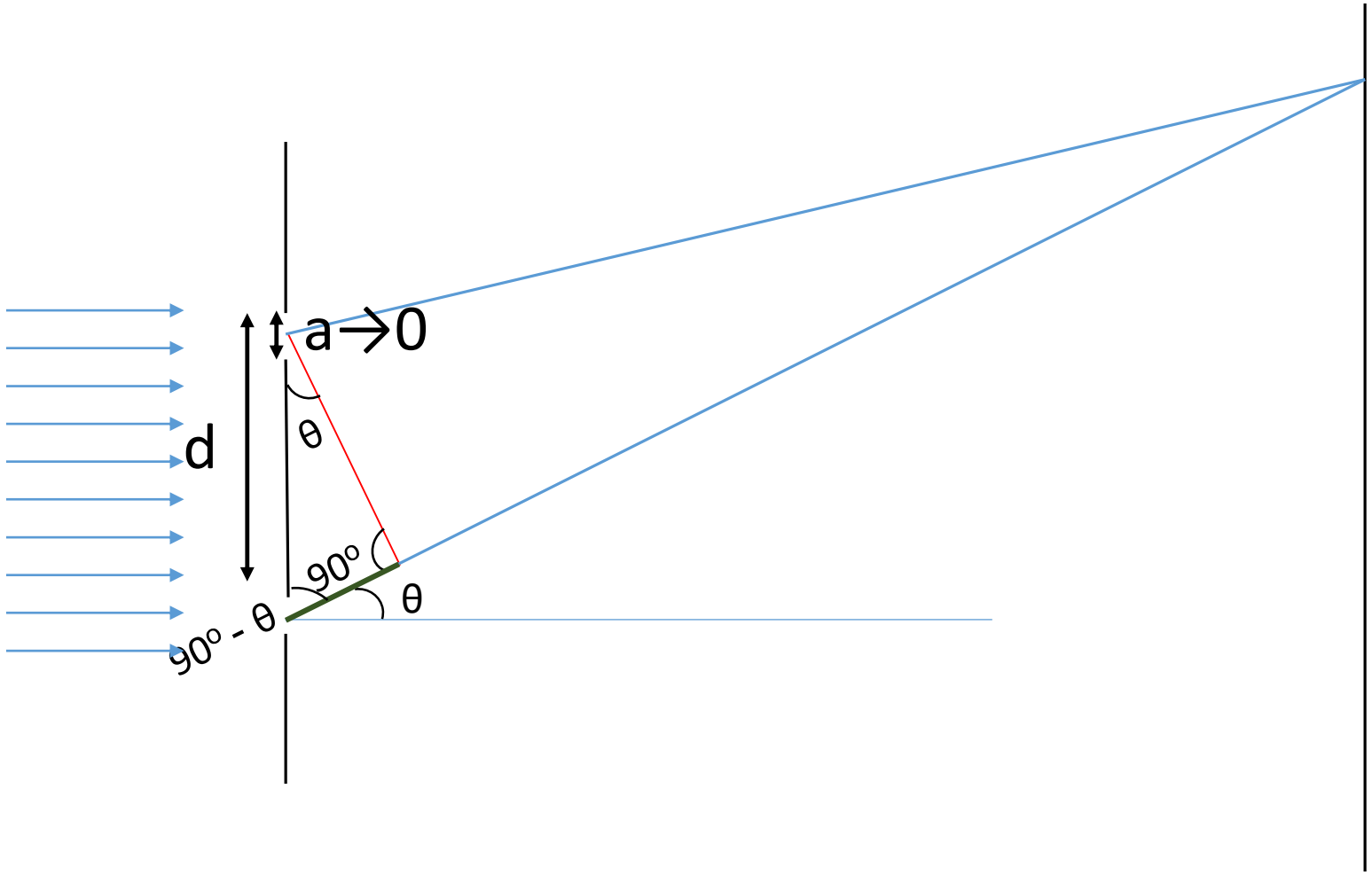
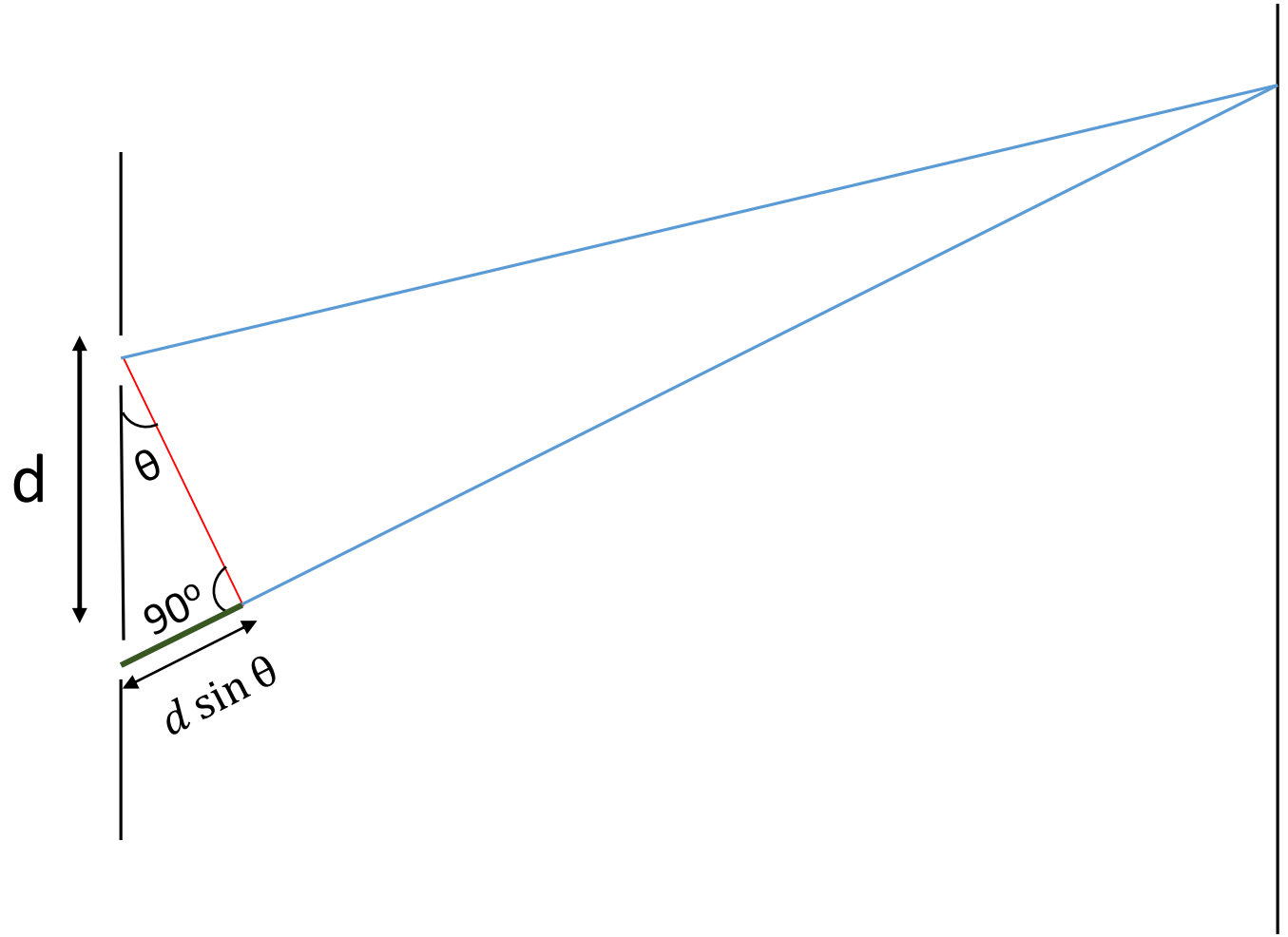
Data track spacing?



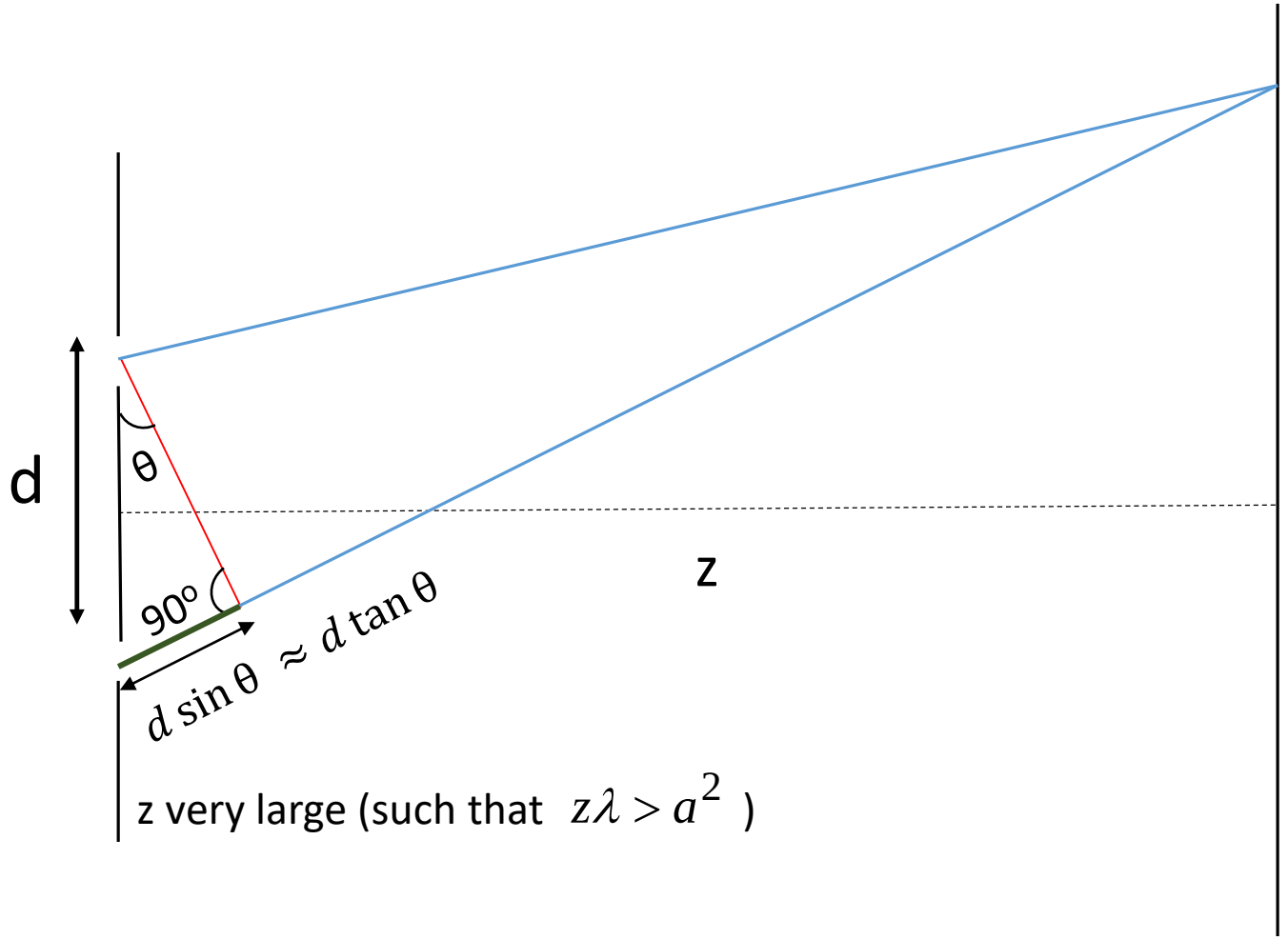
Young’s double slit experiment



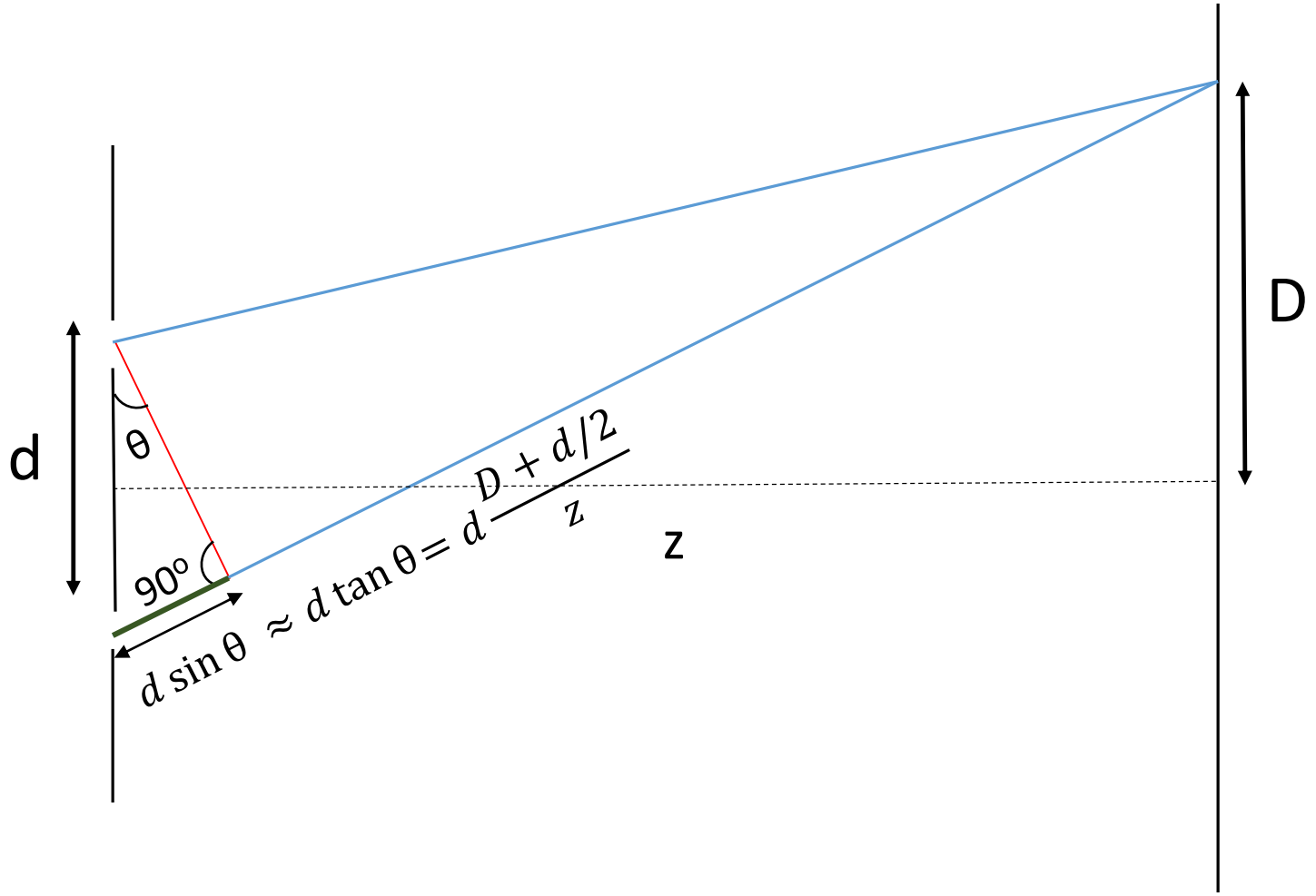
Young’s double slit experiment



Young's double slit experiment



Young's double slit experiment



Young's double slit experiment

$$\frac{2\pi}{\lambda}\left(d\sin\theta\right)=2\pi m$$

$$d\sin\theta=m\lambda$$

$$d\frac{D+d/2}{z}=\lambda$$

$$dD+\frac{d^2}{2}=z\lambda$$

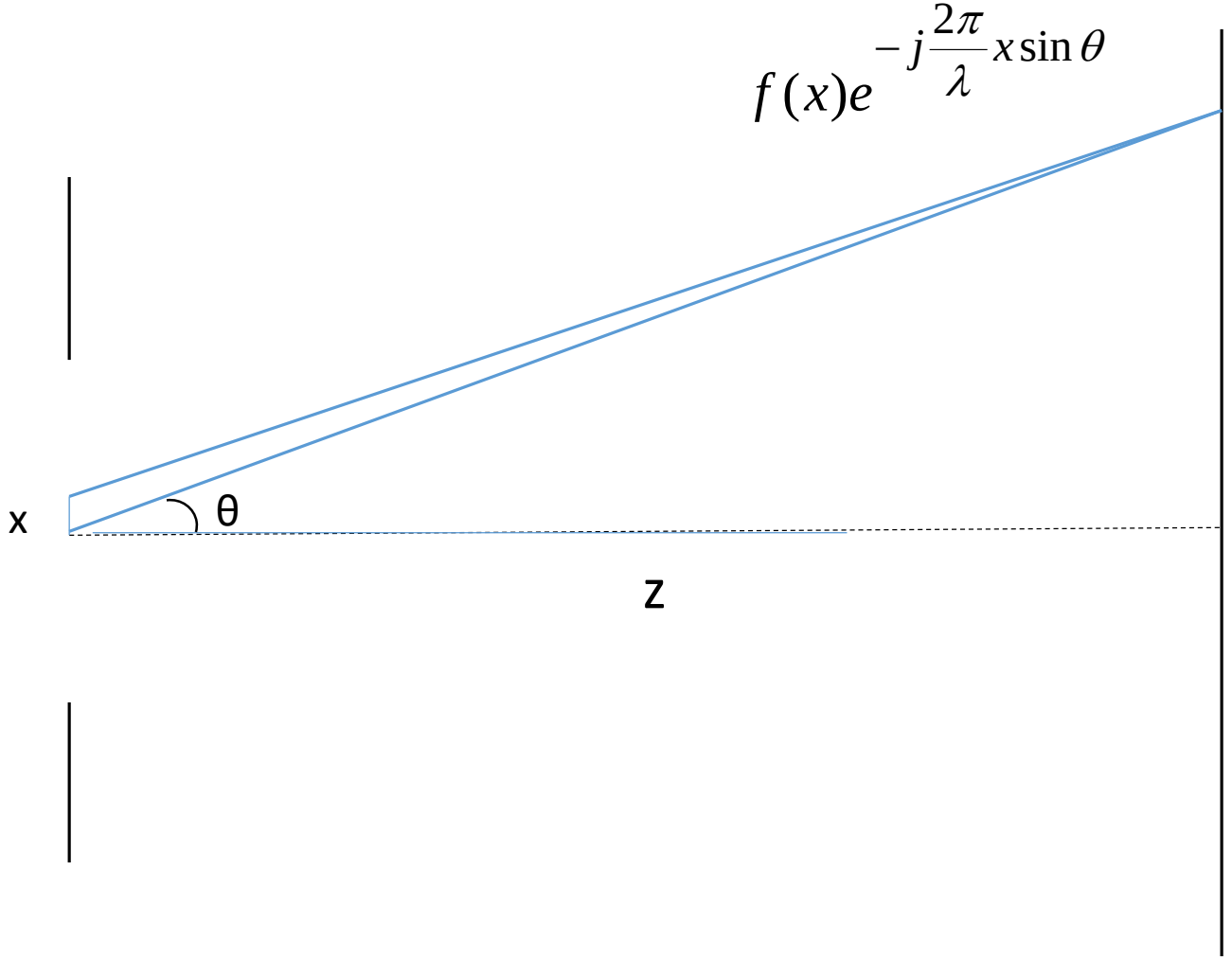
$$d\approx\frac{z\lambda}{D}$$

CD track length

$$d \approx \frac{z\lambda}{D}$$

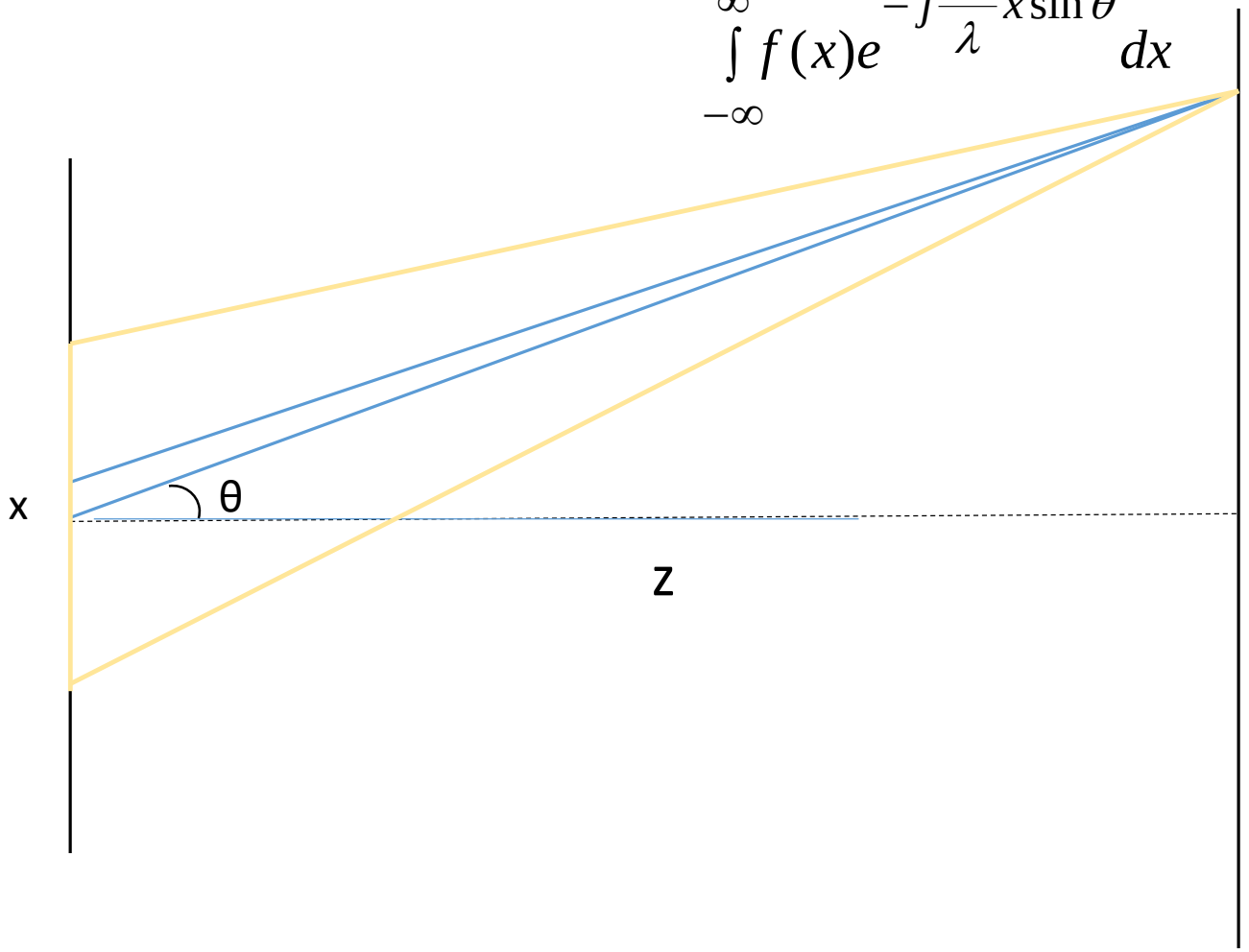
$$d \approx \frac{2.7\ feet \times 600nm}{1\ feet} \approx 1600nm$$

Diffraction (Fraunhofer)



Diffraction (Fraunhofer)

$$\int_{-\infty}^{\infty} f(x) e^{-j\frac{2\pi}{\lambda} x \sin\theta} dx$$



Diffraction (Fraunhofer)

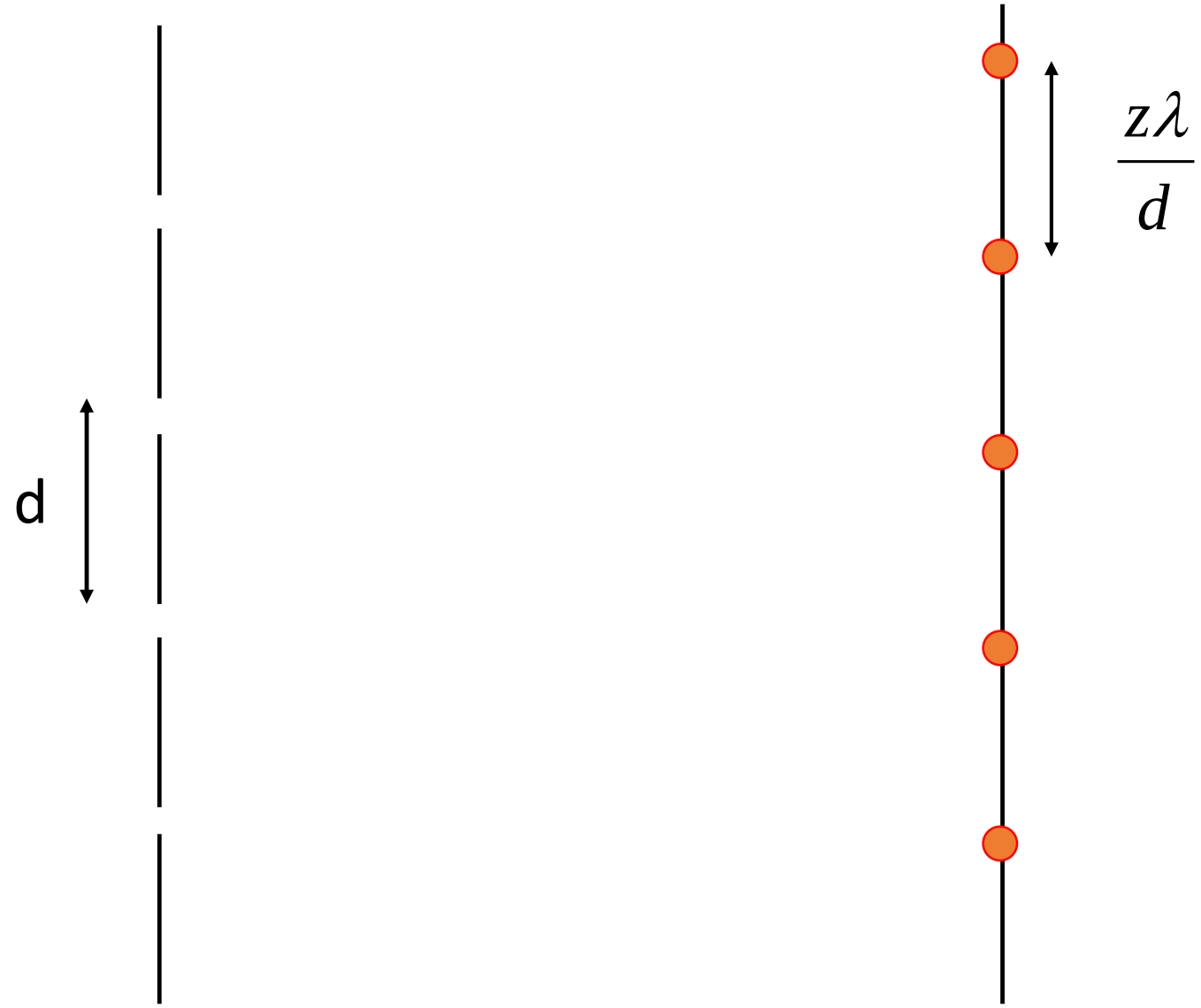
$$F(\theta) = \int_{-\infty}^{\infty} f(x) e^{-j\frac{2\pi}{\lambda} x \sin\theta} dx$$

$$F(\theta) = \int_{-\infty}^{\infty} f(x) e^{-j\frac{2\pi}{\lambda} x\theta} dx$$

$$\omega = \frac{2\pi\theta}{\lambda}$$

$$F(\omega) = \int_{-\infty}^{\infty} f(x) e^{-j\omega x} dx$$

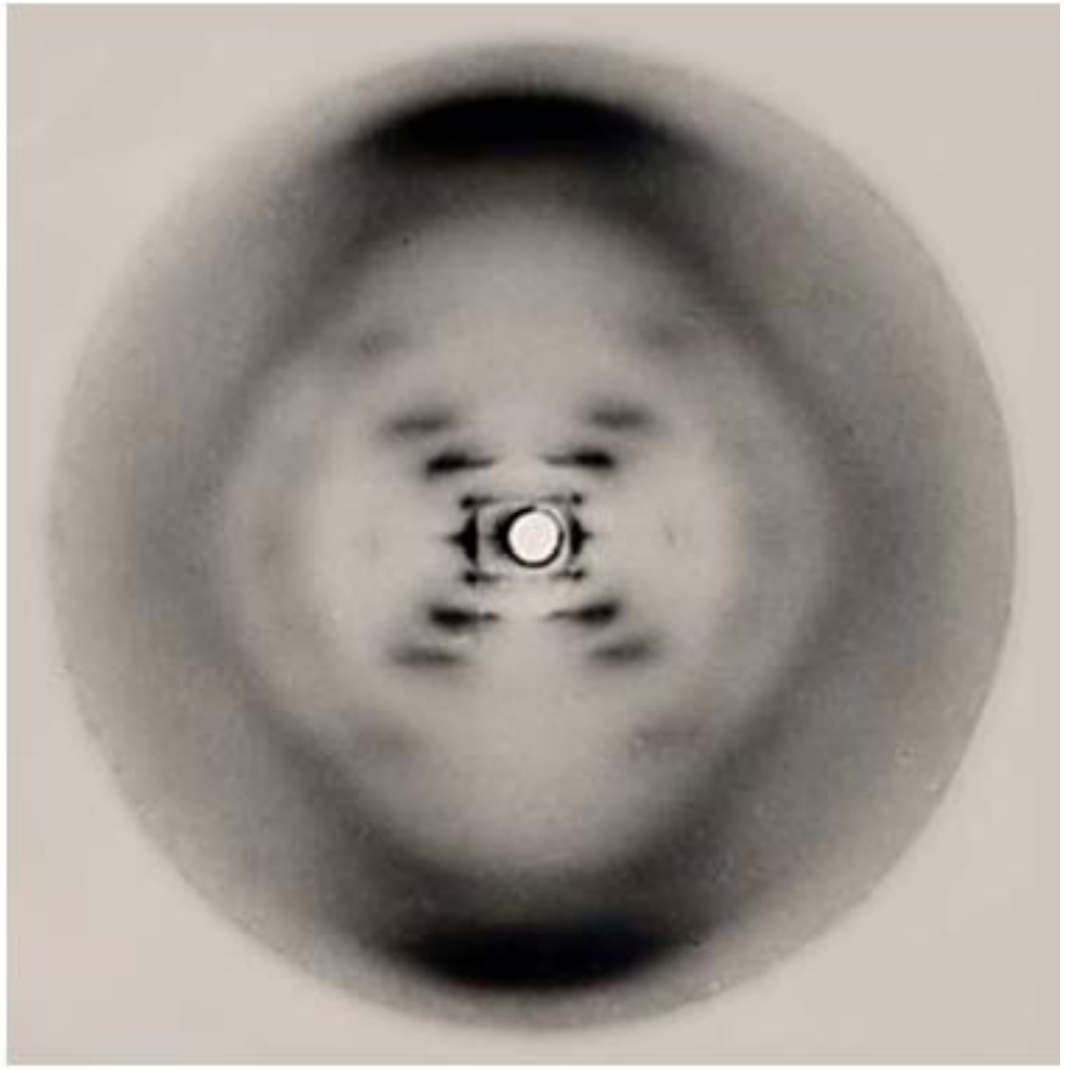
Diffraction (Fraunhofer)



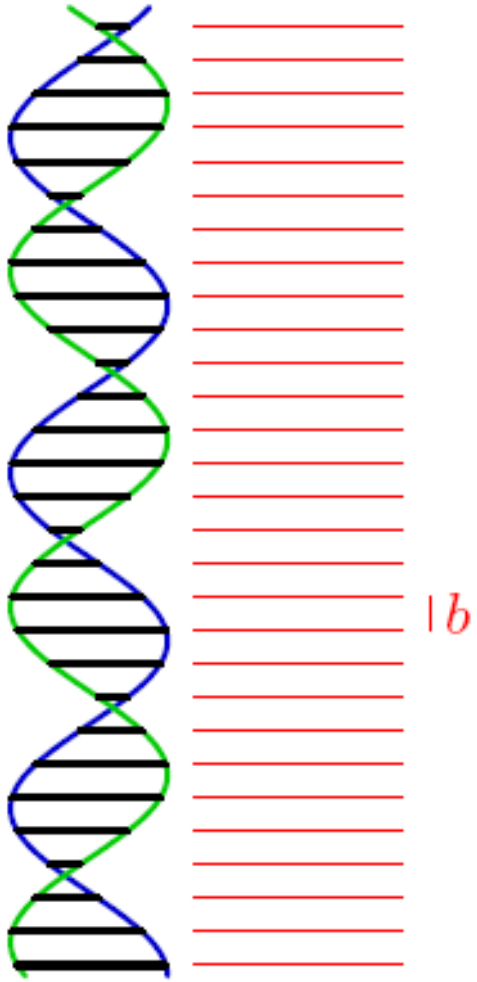
Halftone dots noise

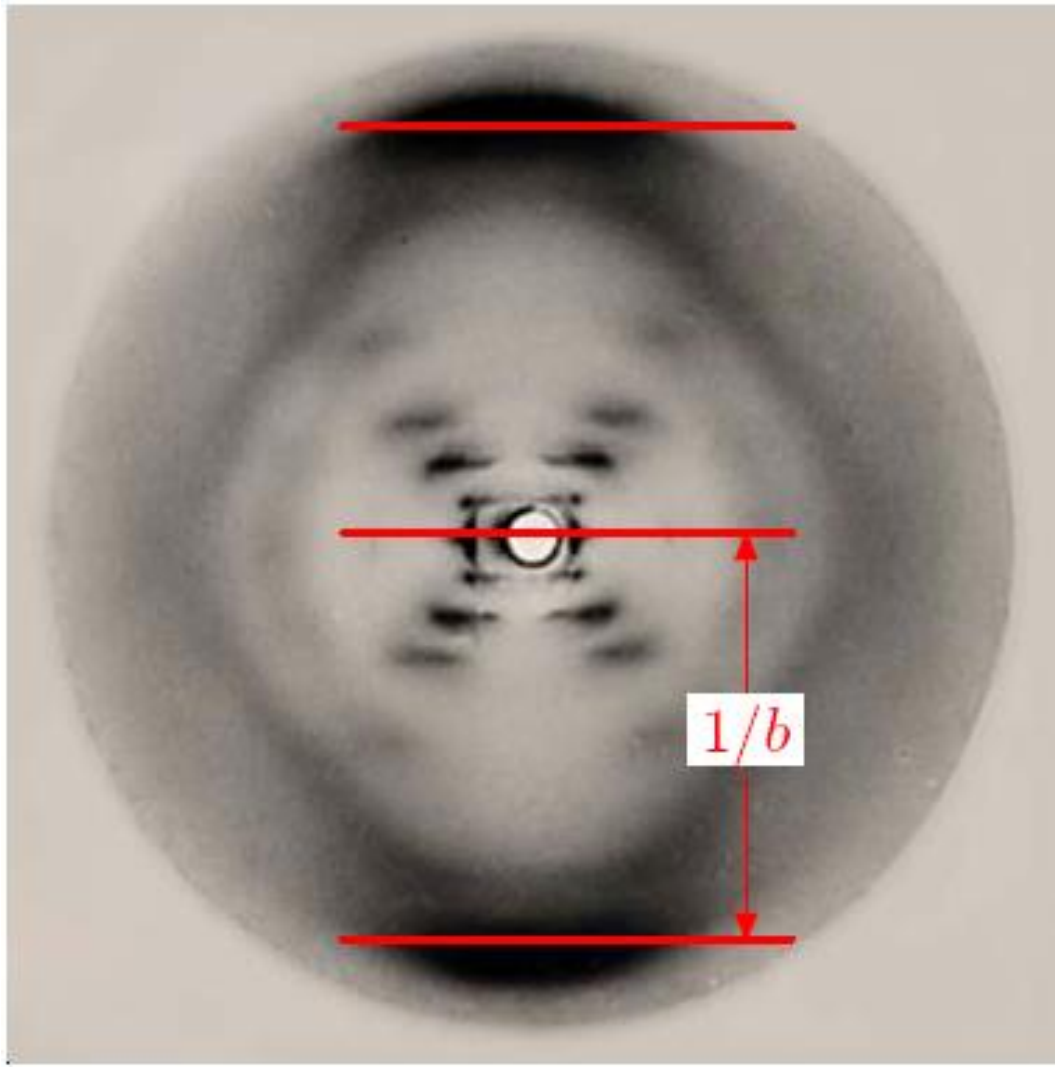
Optical Low pass filter

Rosalind Franklin Image of double helix

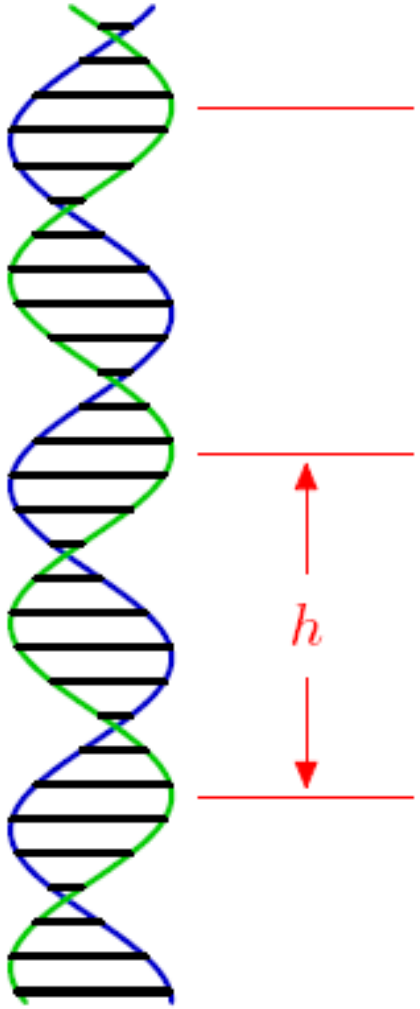


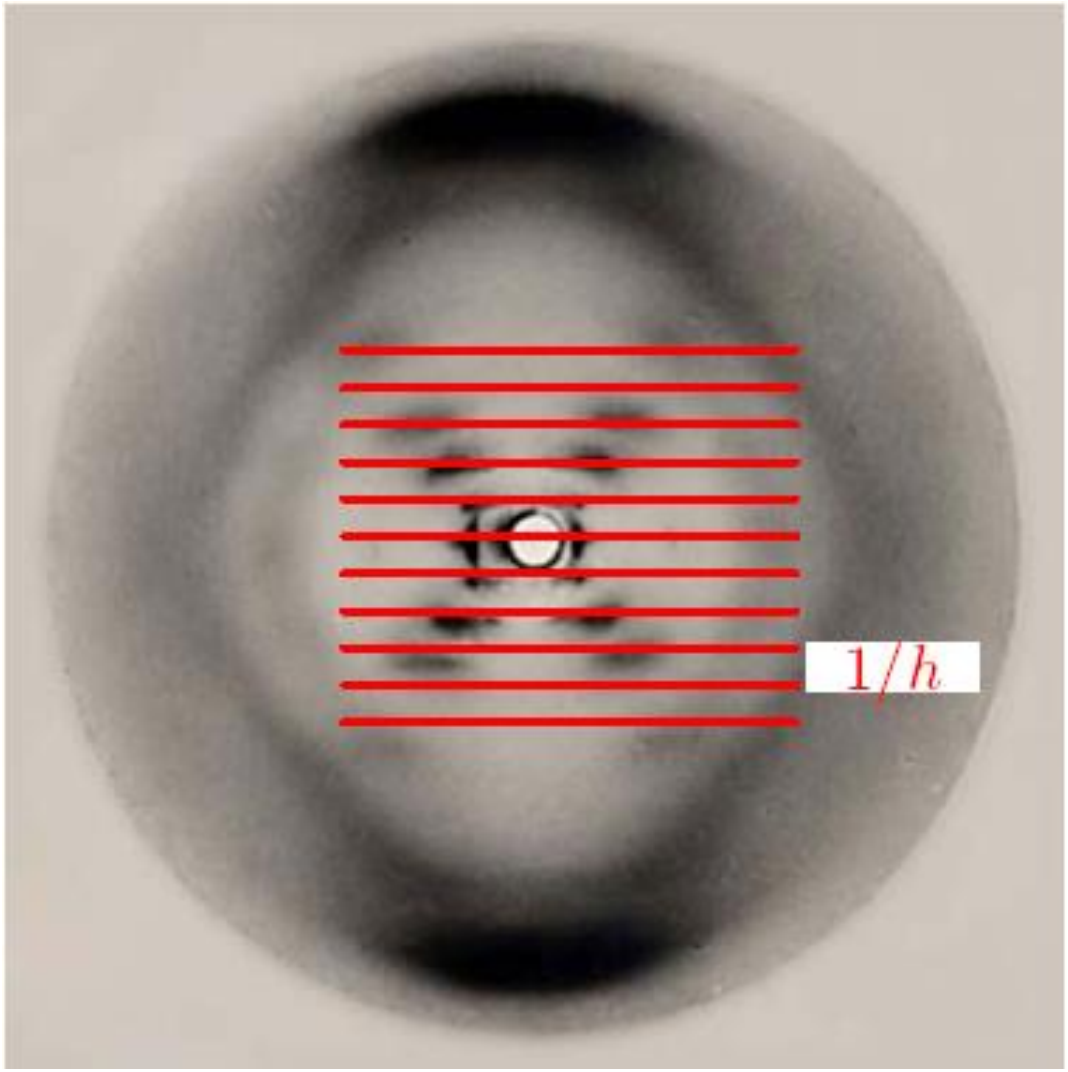
Rosalind Franklin Image of double helix





Rosalind Franklin Image of double helix





Rosalind Franklin Image of double helix