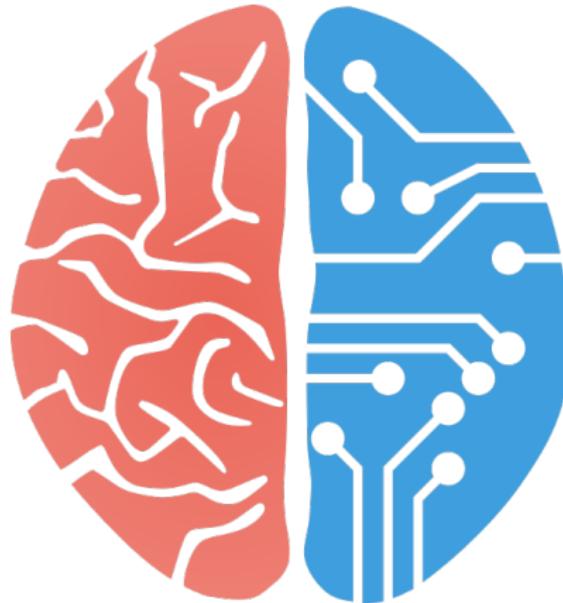


Hvordan kan vi modelere hjernen med en datamaskin?

Simen Tennøe







Grunnlegende nevrovitenskap



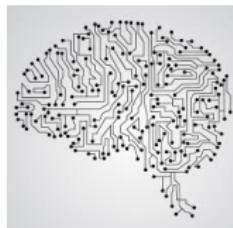
Grunnlegende nevrovitenskap



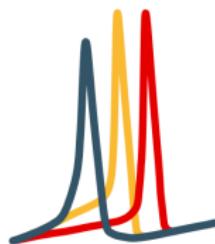
Beregningsorientert nevrovitenskap



Grunnlegende nevrovitenskap



Beregningsorientert nevrovitenskap



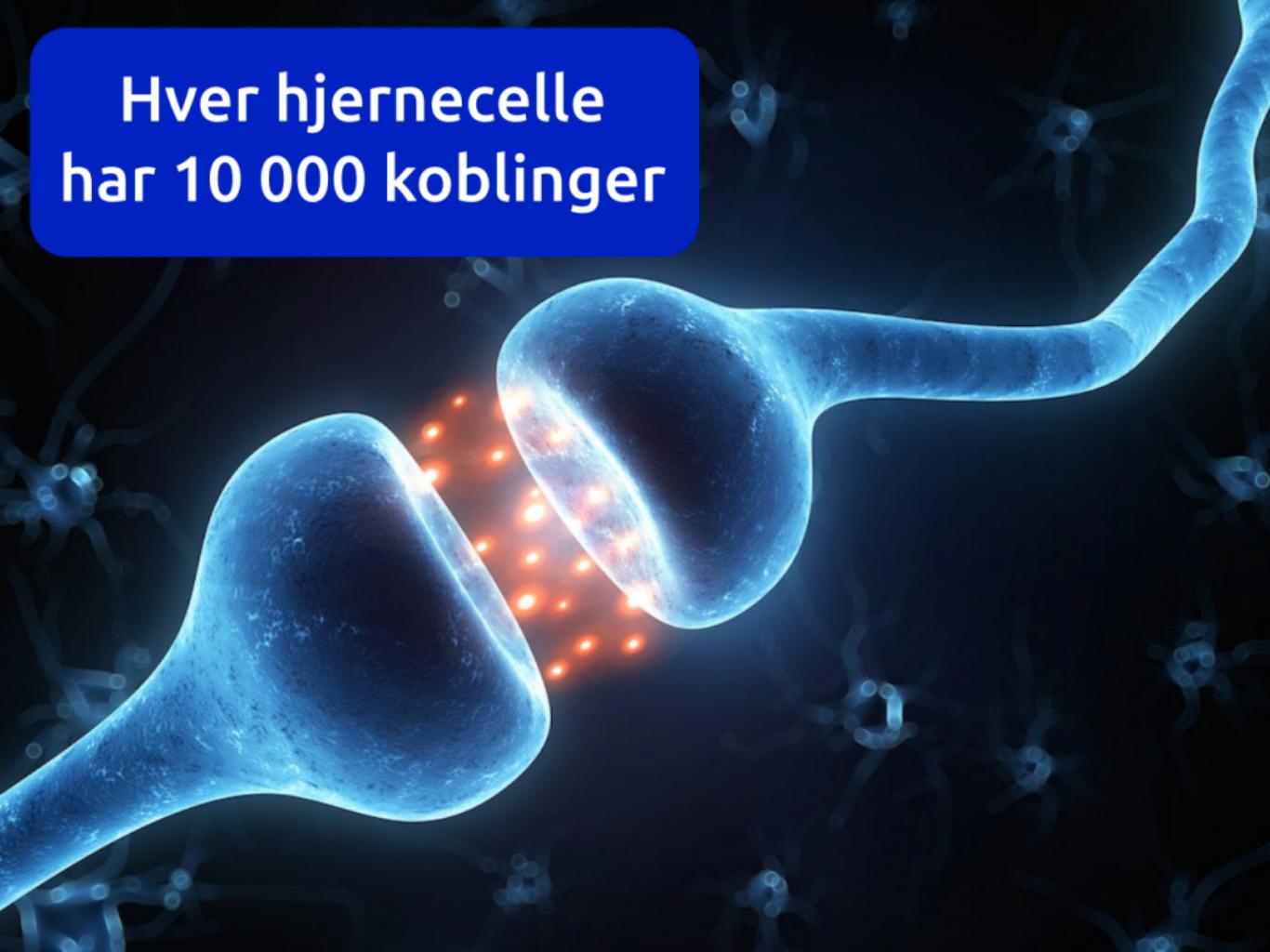
Usikkerhet i nevrovitenskap





86 000 000 000
hjerneceller

Hver hjernecelle
har 10 000 koblinger



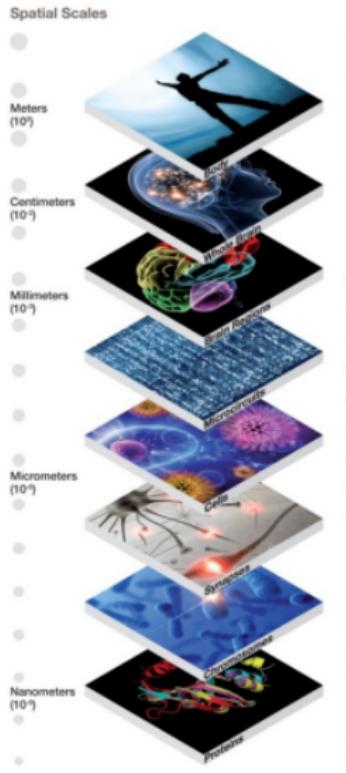
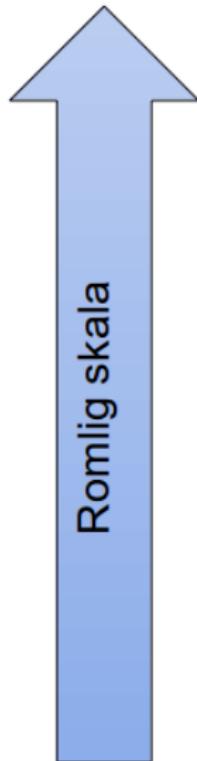


Figure 4: From molecules to the body: spatial scales for the brain's different levels of organization span nine orders of magnitude.

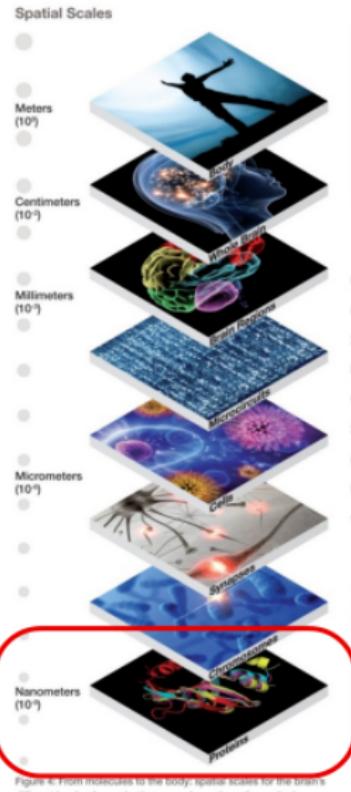
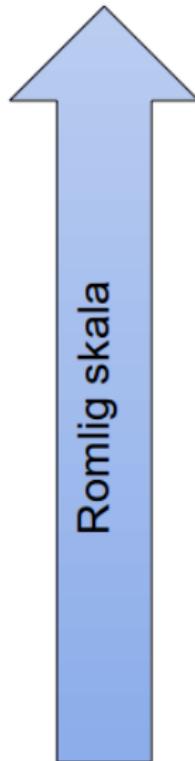


Figure 6: From macroscopic to the body, spatial scales for the brain's different levels of organization span nine orders of magnitude.

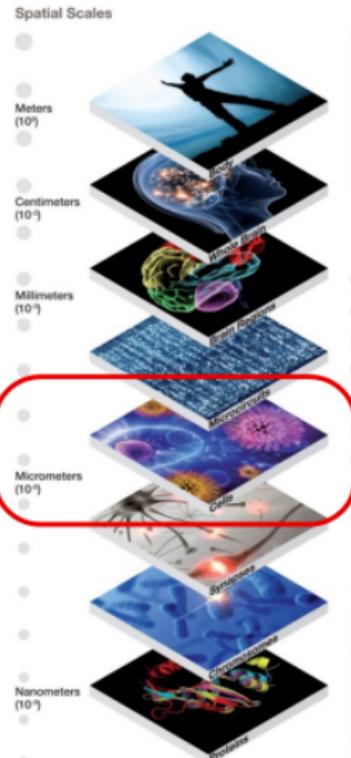
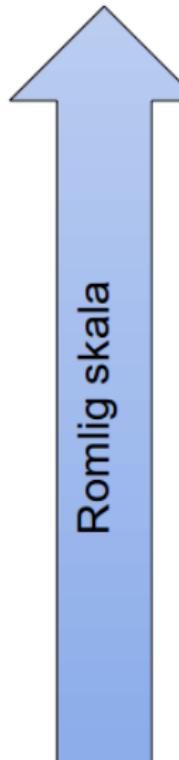


Figure 4: From molecules to the body: spatial scales for the brain's different levels of organization span nine orders of magnitude.

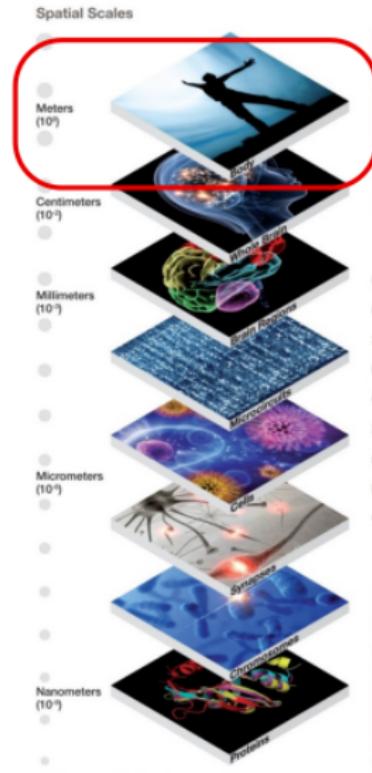
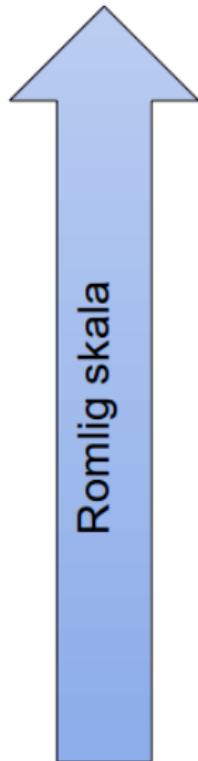


Figure 4: From molecules to the body: spatial scales for the brain's different levels of organization span nine orders of magnitude.

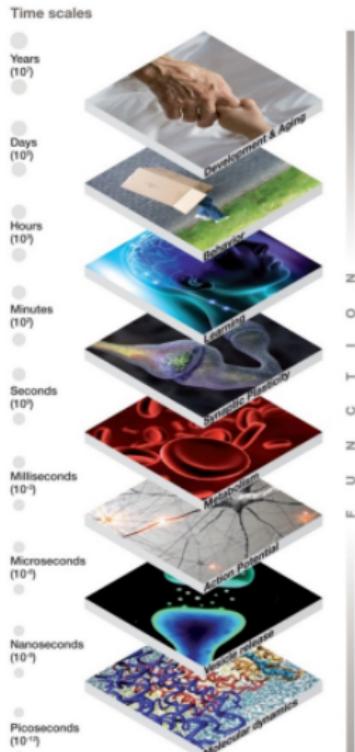
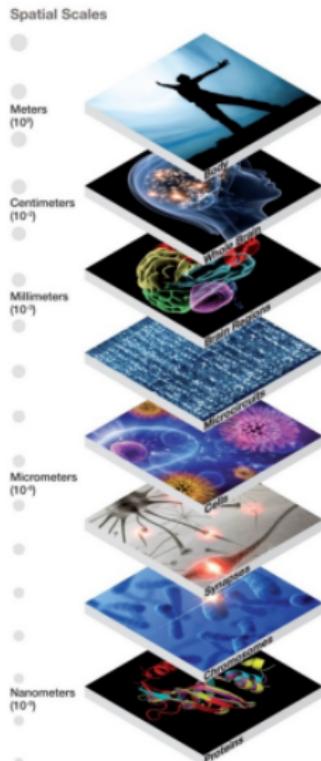
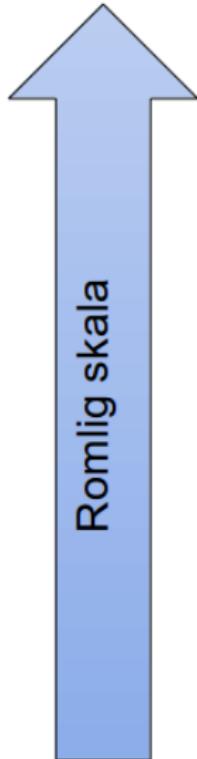


Figure 4: From molecules to the body: spatial scales for the brain's different levels of organization span nine orders of magnitude.

Figure 27: From molecular dynamics to development and aging: time scales span nineteen orders of magnitude.

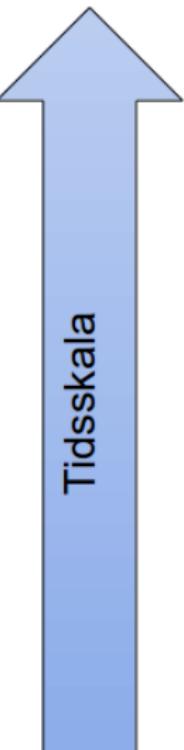
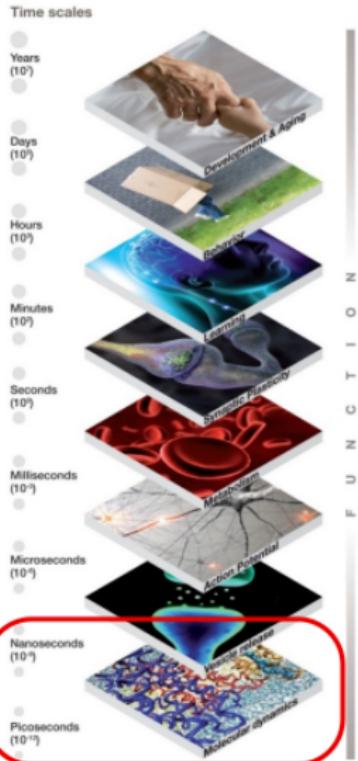
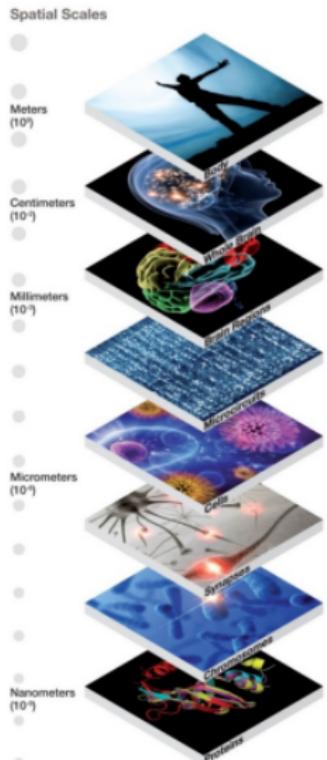
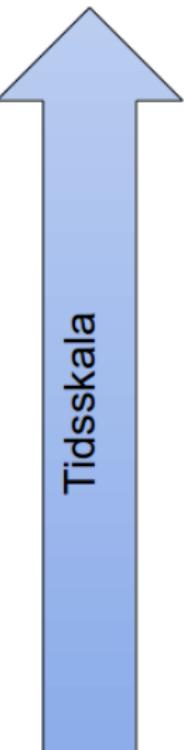
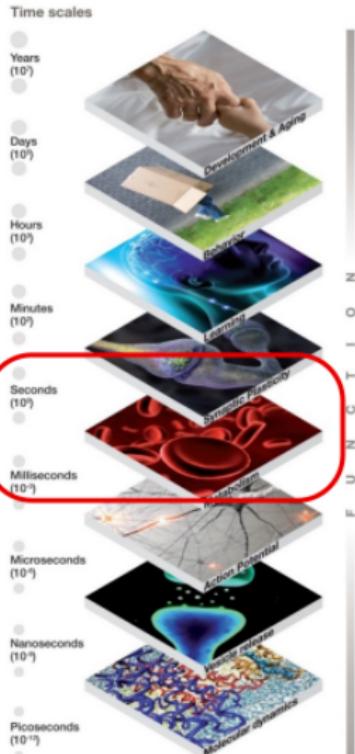
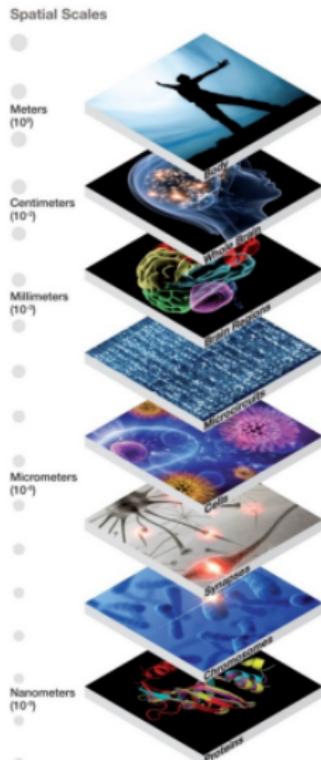


Figure 4: From molecules to the body: spatial scales for the brain's different levels of organization span nine orders of magnitude.

Figure 27: From molecular dynamics to development and aging: time scales span nineteen orders of magnitude.



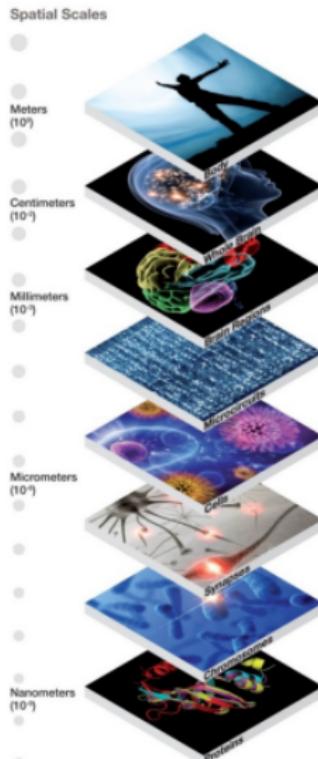
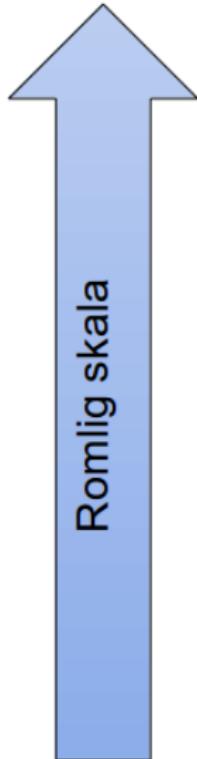


Figure 4: From molecules to the body: spatial scales for the brain's different levels of organization span nine orders of magnitude.

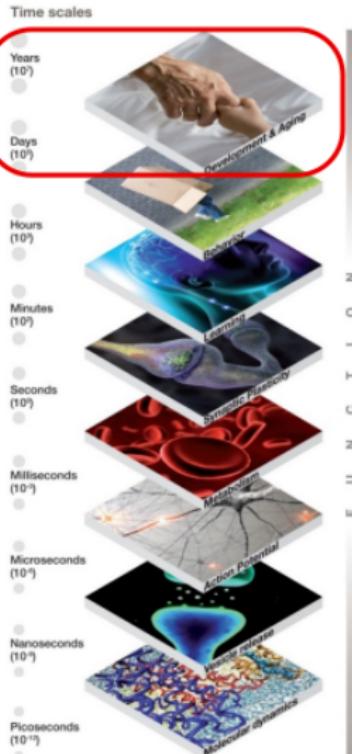
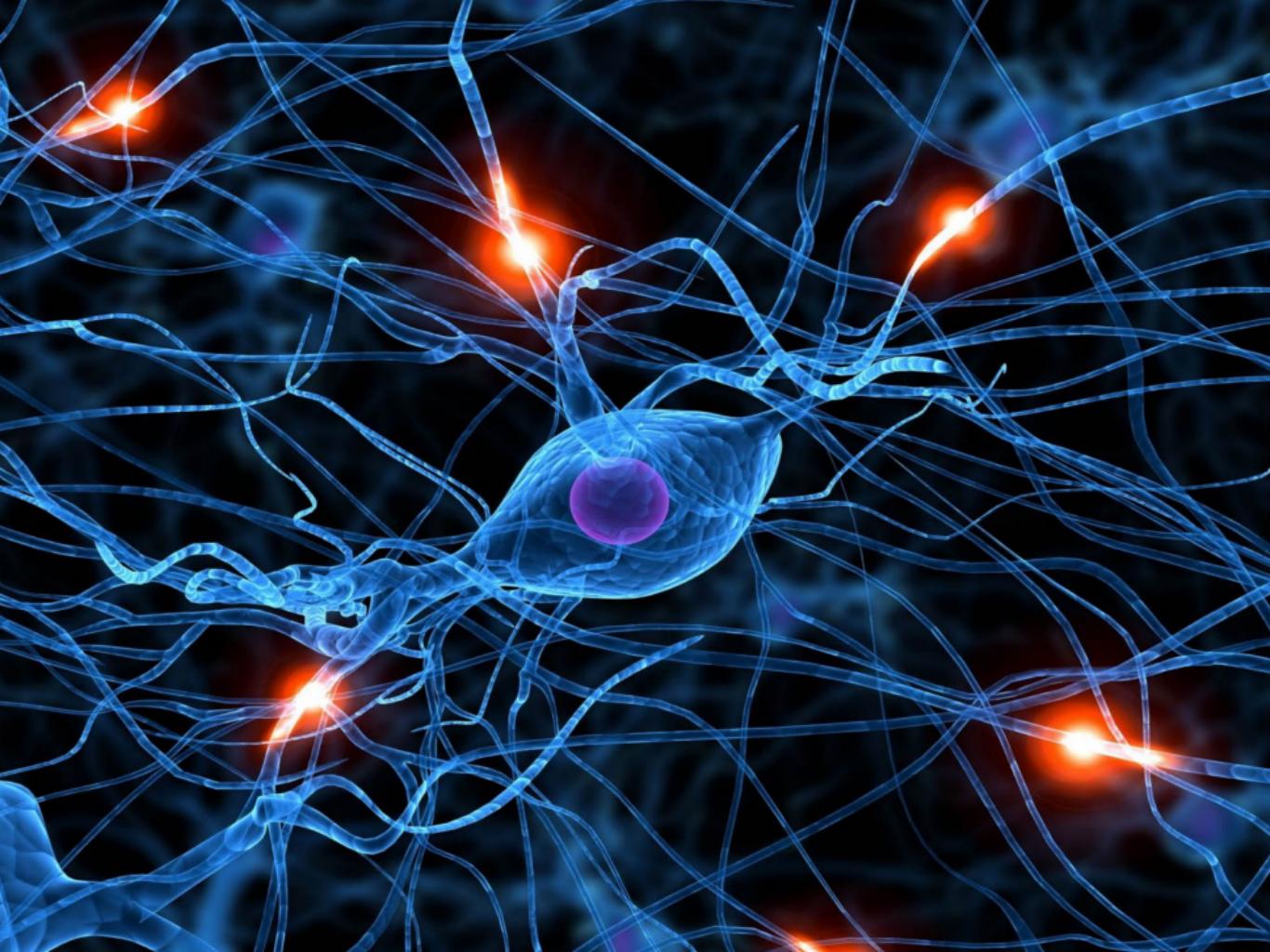
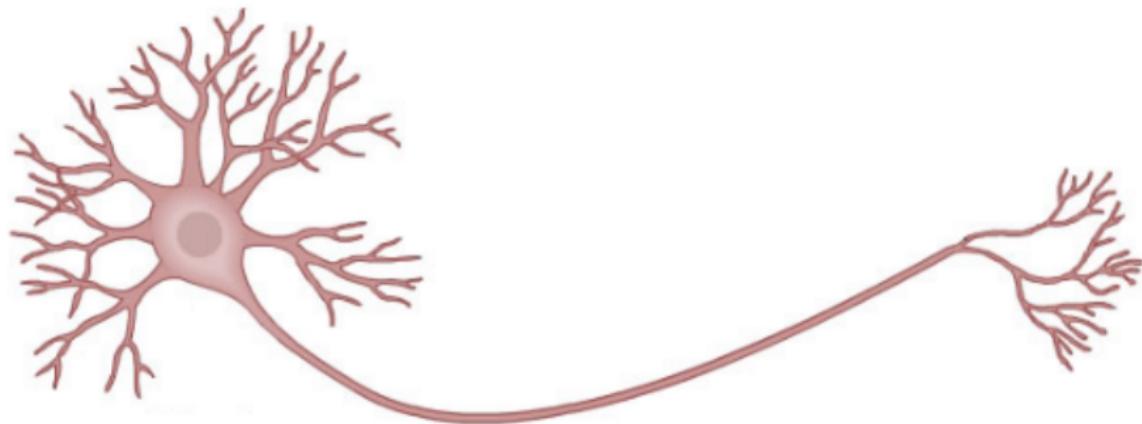
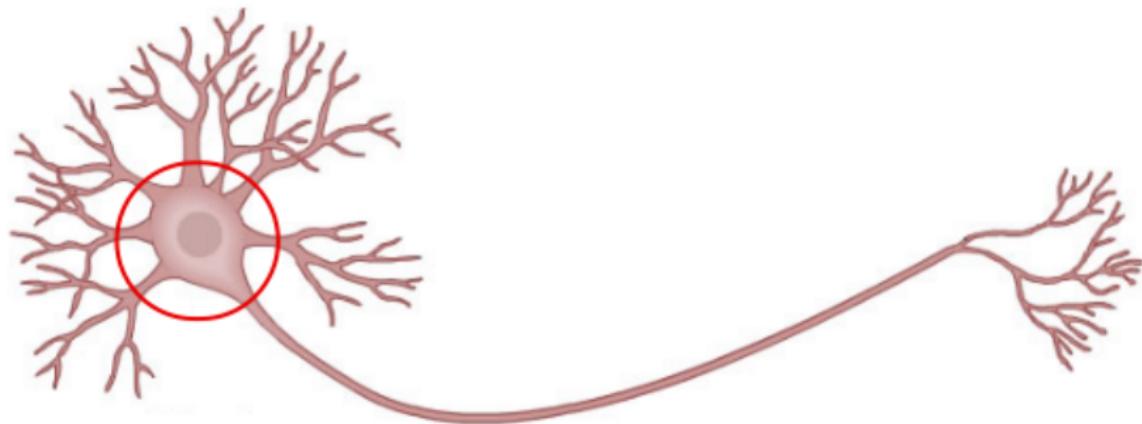


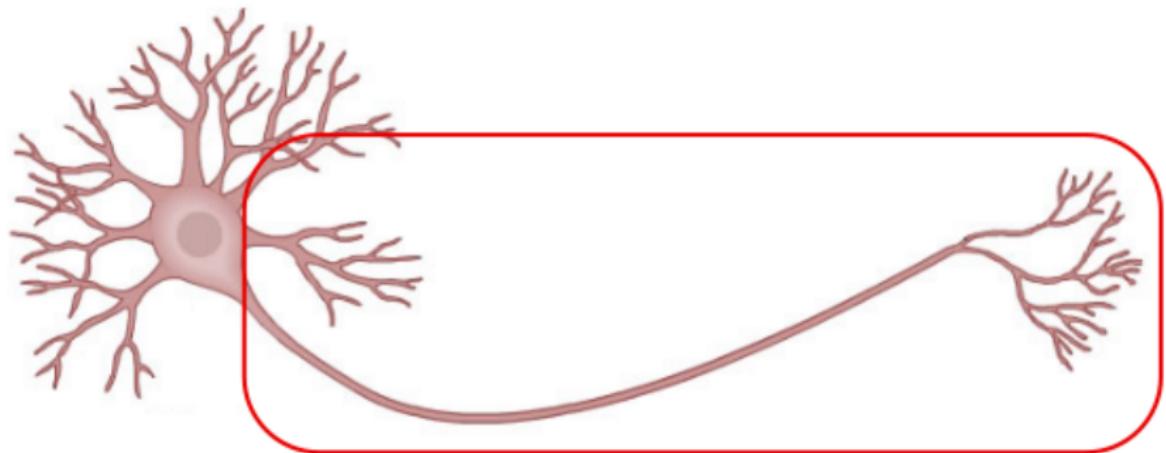
Figure 27: From molecular dynamics to development and aging: time scales span nineteen orders of magnitude.

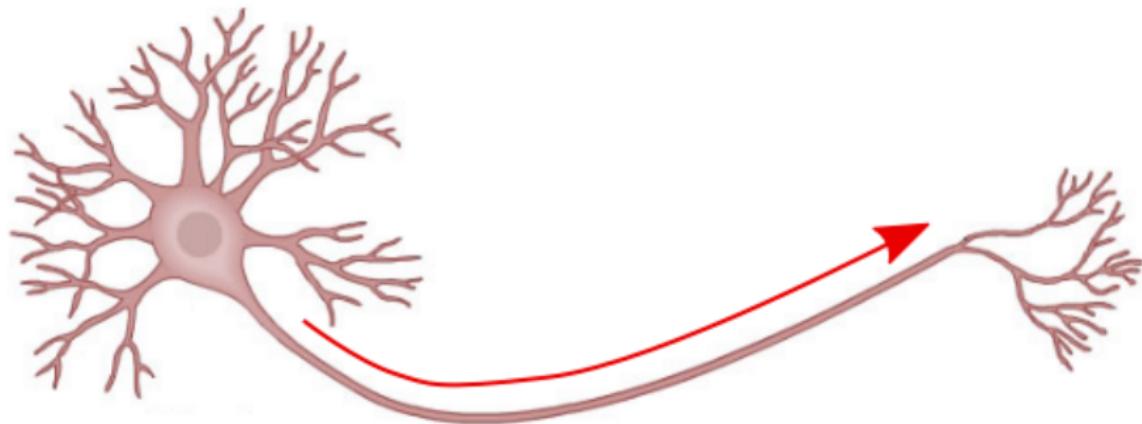


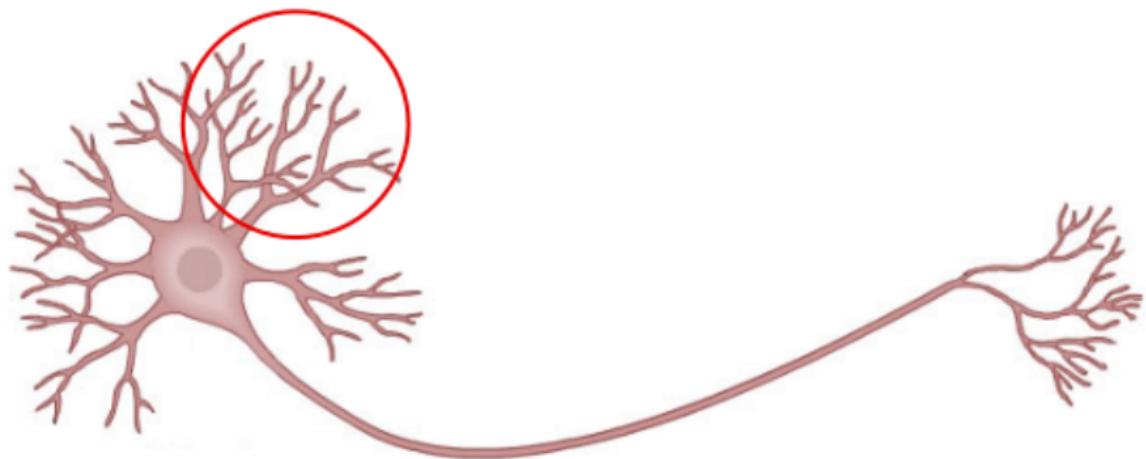






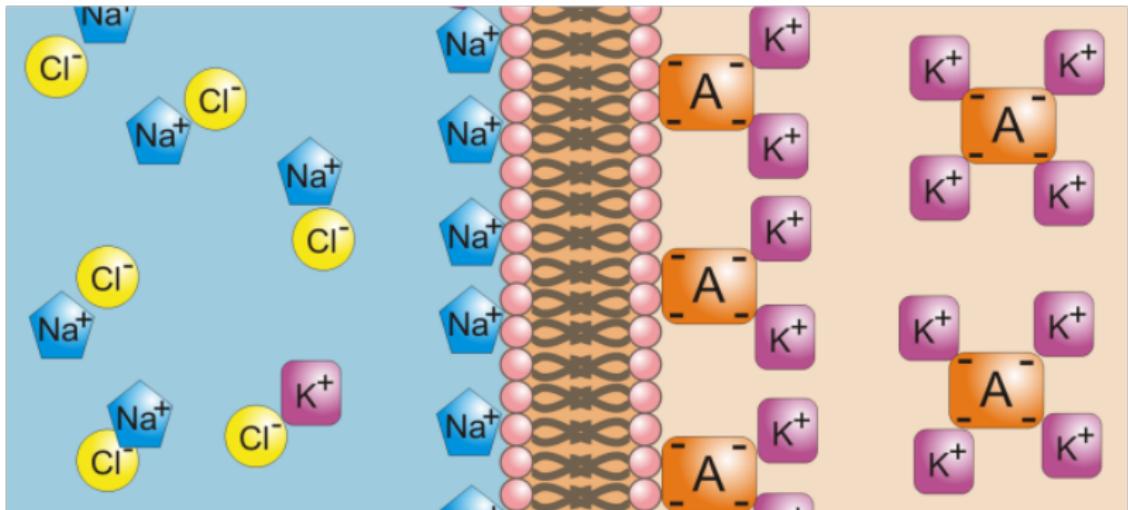








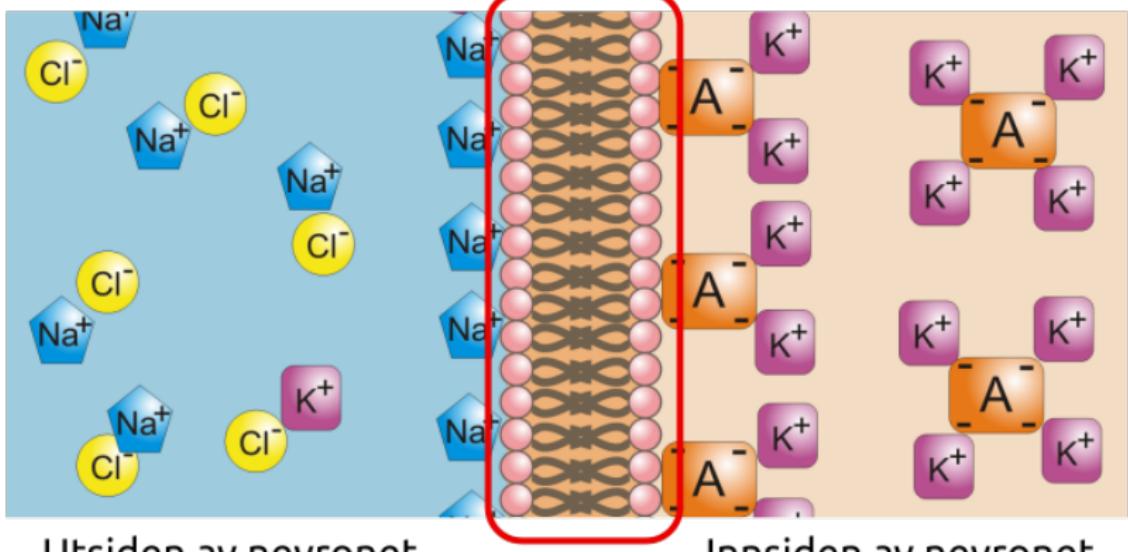
Cellemembran



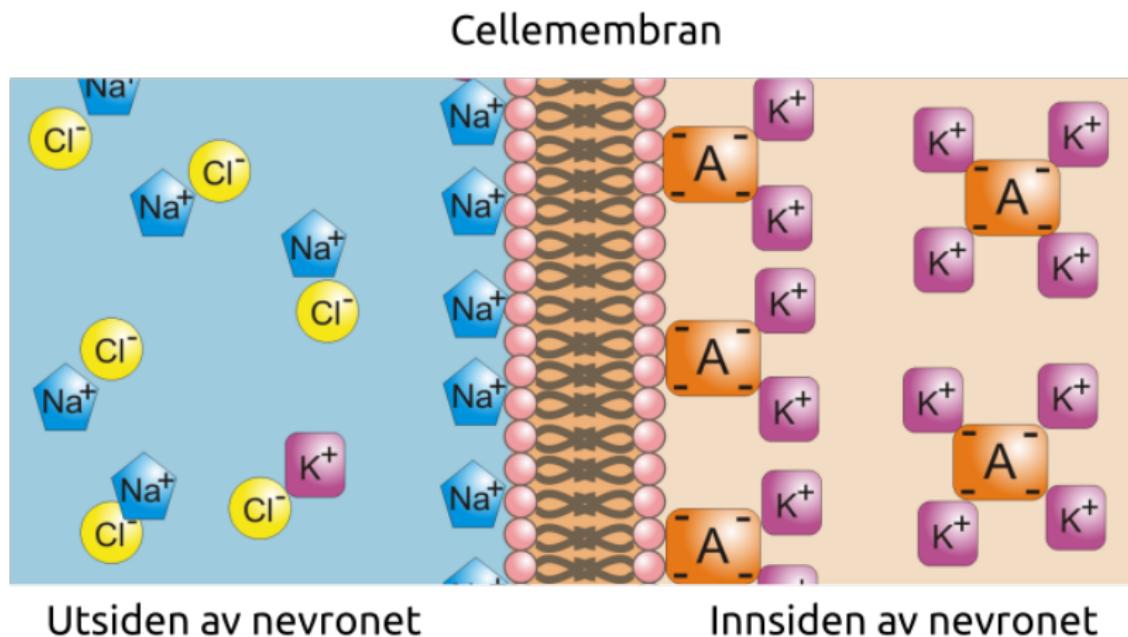
Utsiden av nevronet

Innsiden av nevronet

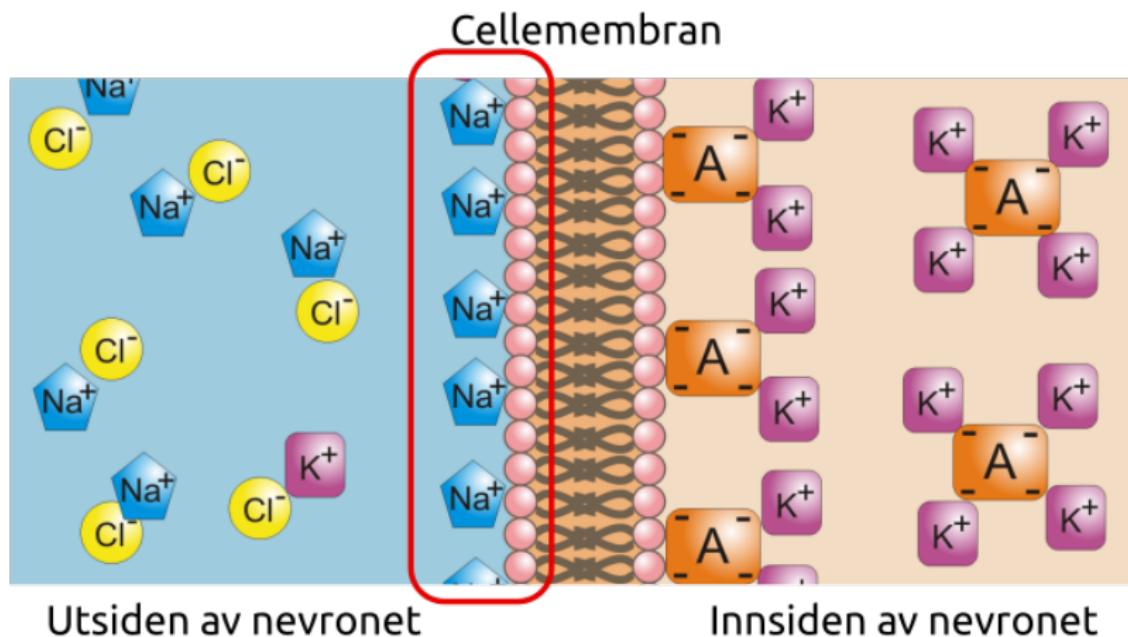
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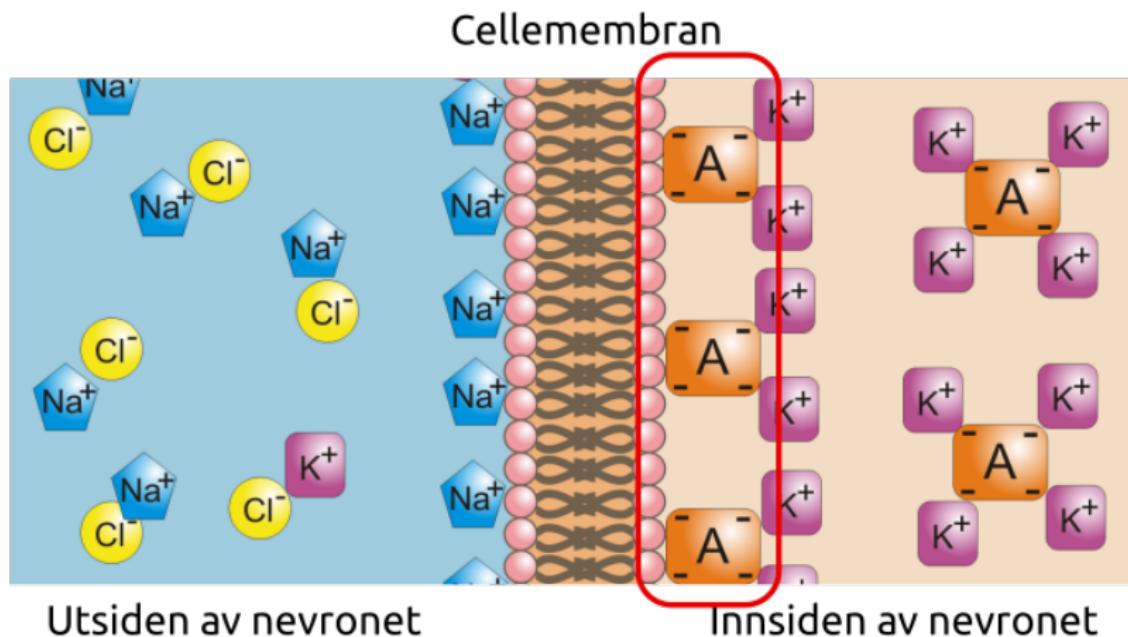
Forskjellig konsentrasjon av positive og negative ioner (elektriske ladninger) setter opp ett elektrisk felt



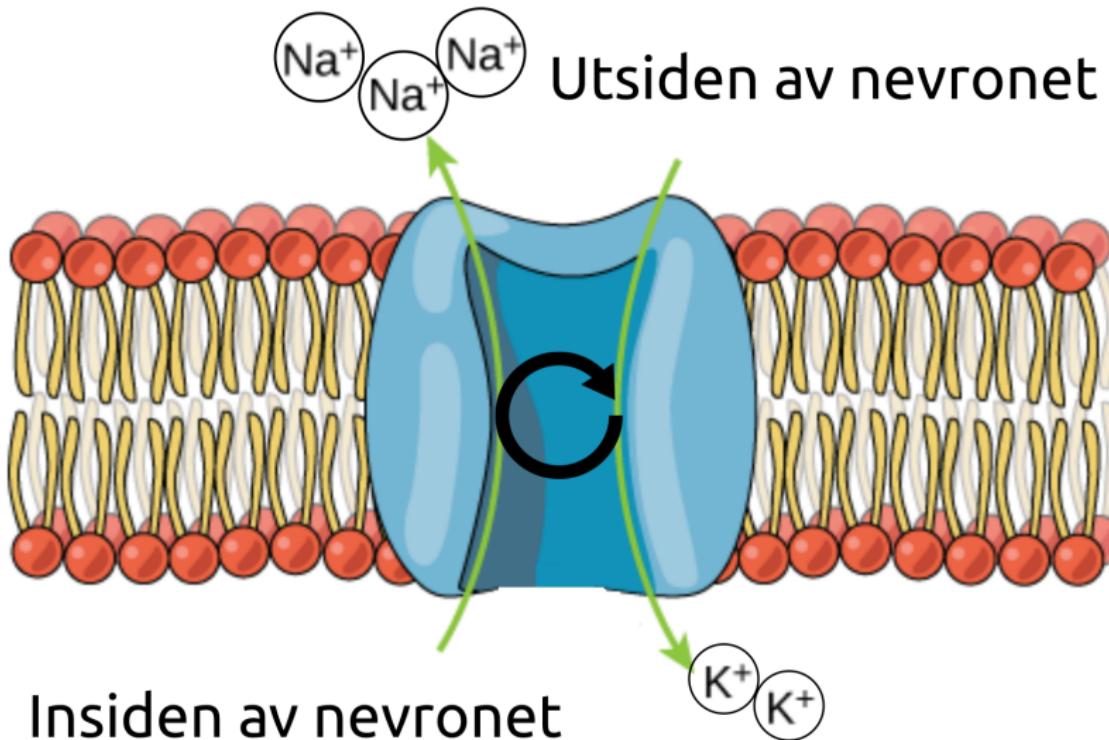
Forskjellig konsentrasjon av positive og negative ioner (elektriske ladninger) setter opp ett elektrisk felt



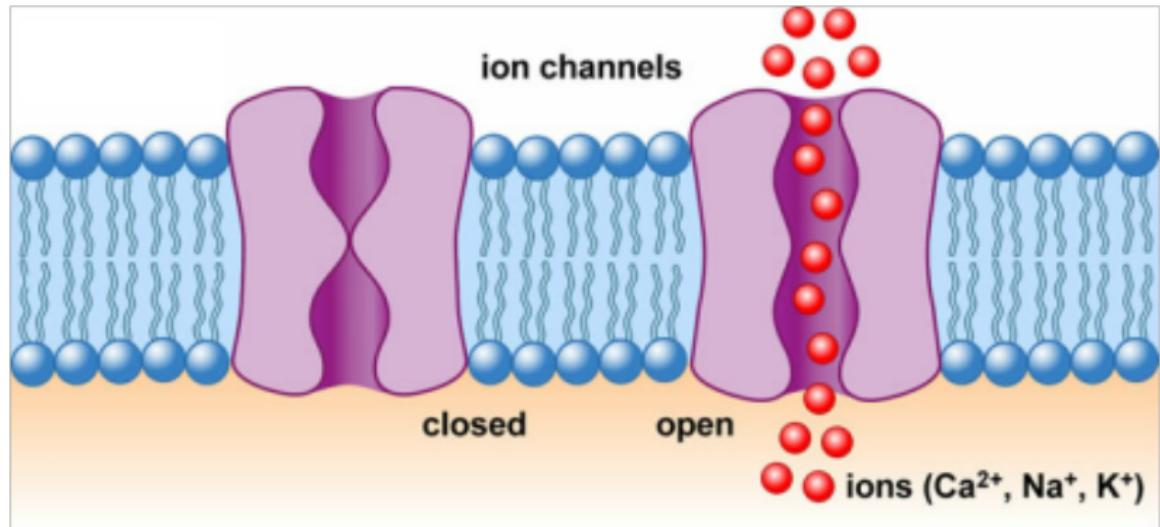
Forskjellig konsentrasjon av positive og negative ioner (elektriske ladninger) setter opp ett elektrisk felt



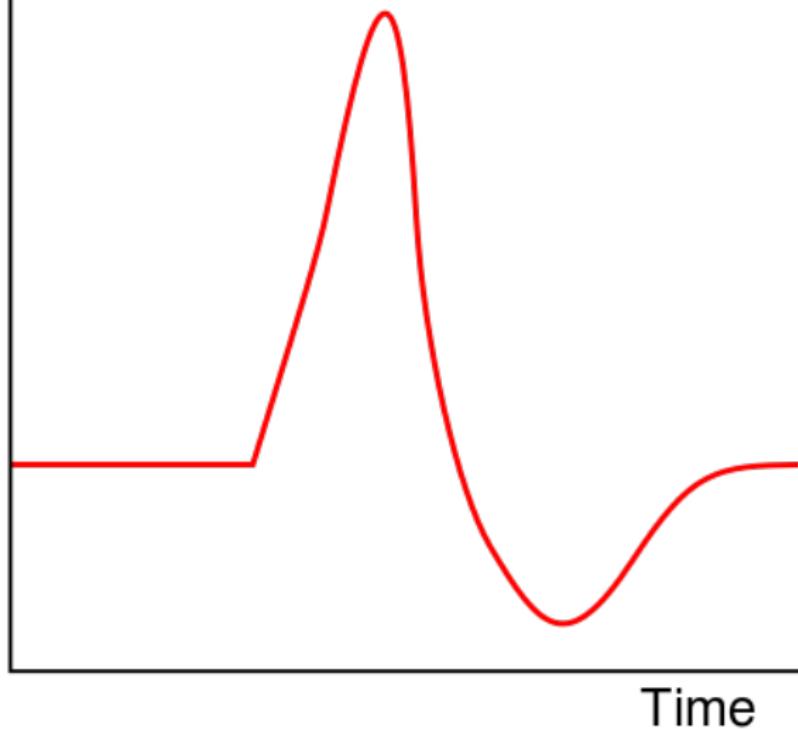
Ione pumper flytter ioner over cellemembranen

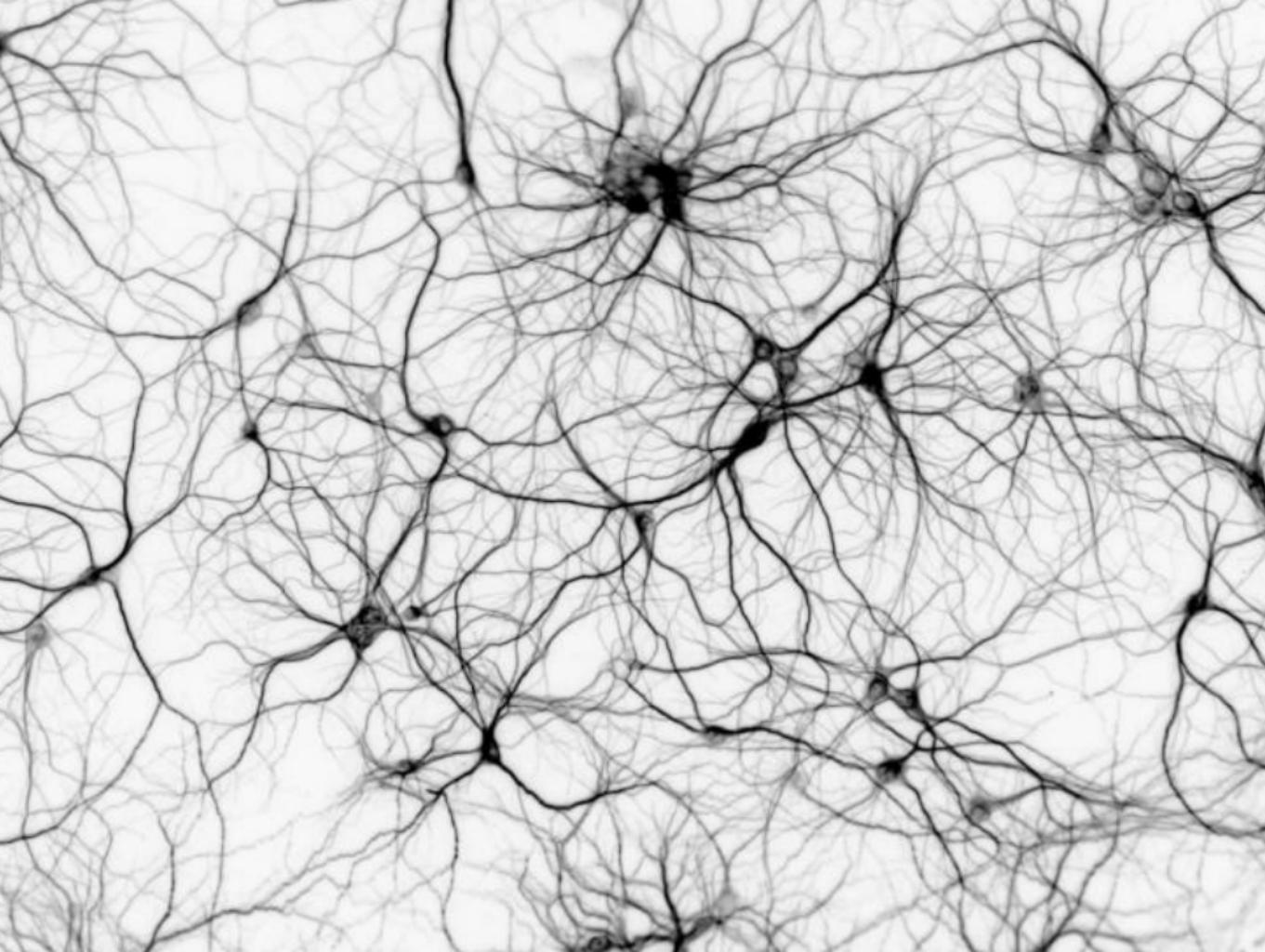


Ione kanaler åpnes og slipper raskt ut ioner



Membrane
potential



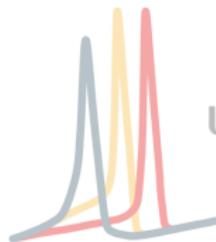




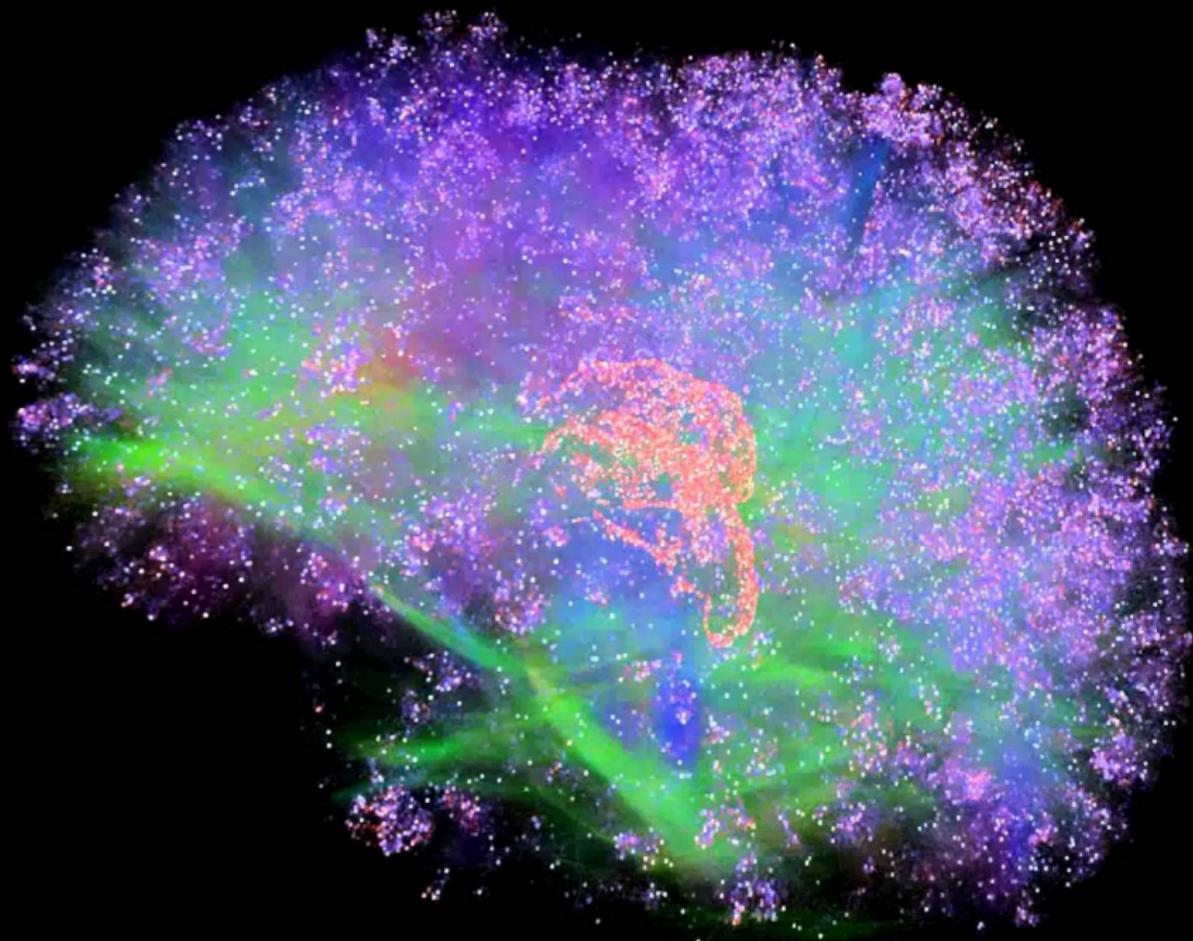
Grunnlegende nevrovitenskap



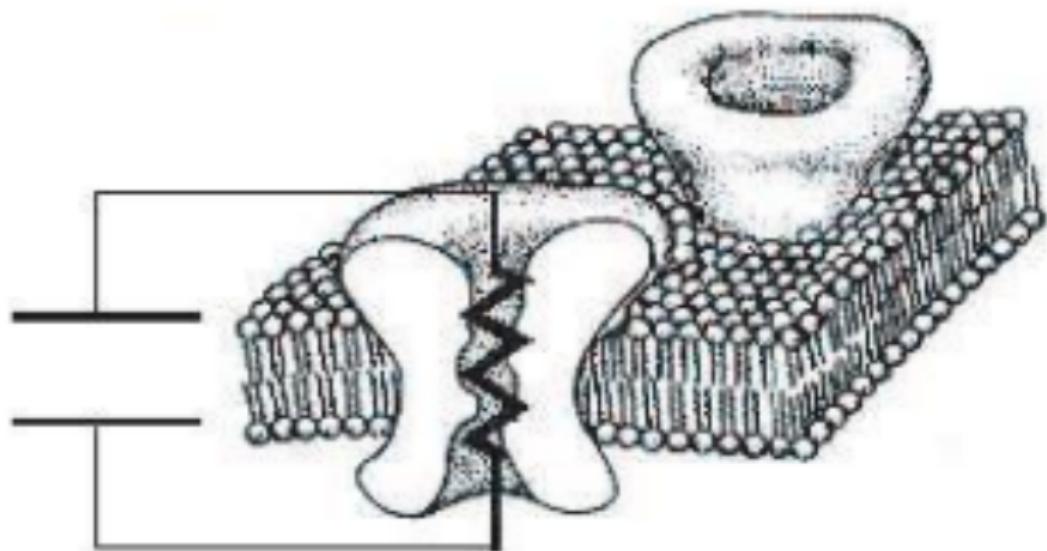
Beregningsorientert nevrovitenskap



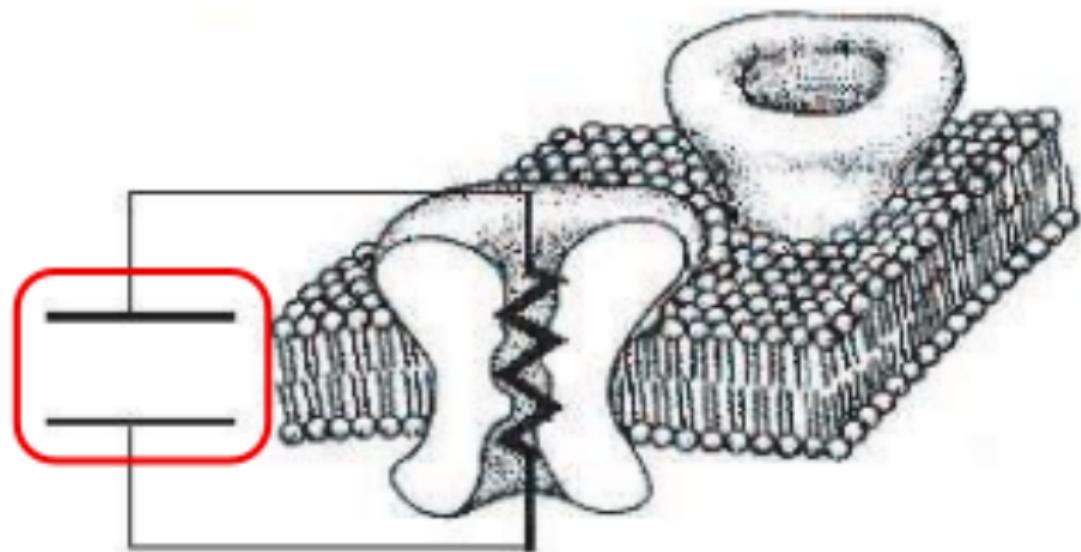
Usikkerhet i nevrovitenskap



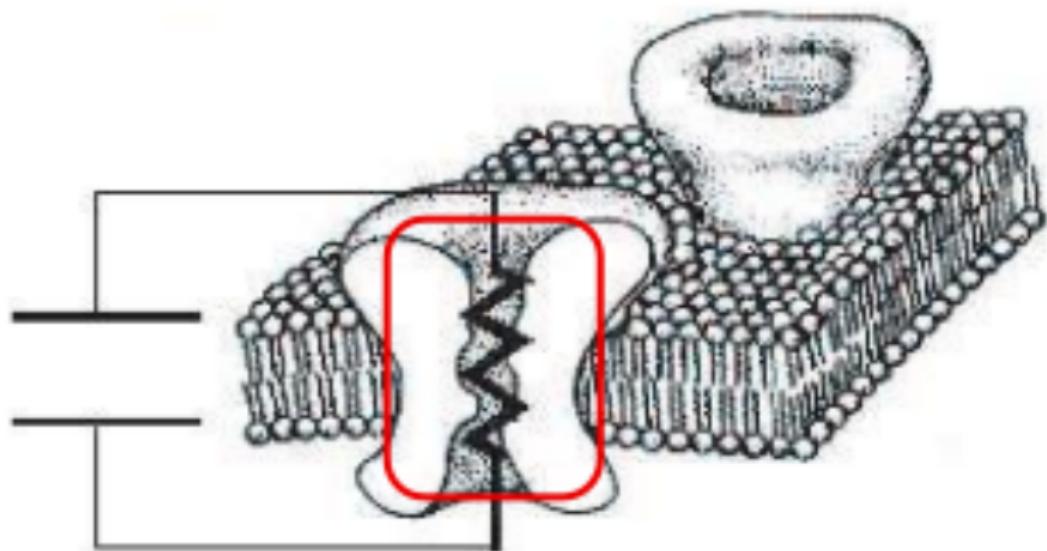
Ett nevron kan modeleres som en elektrisk krets



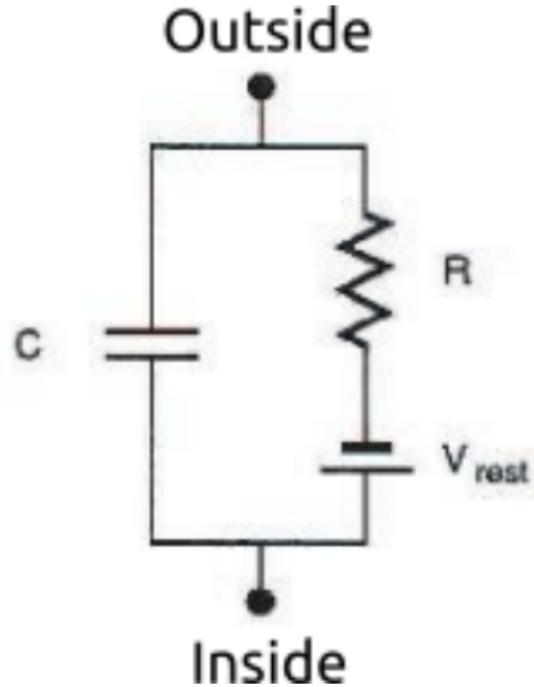
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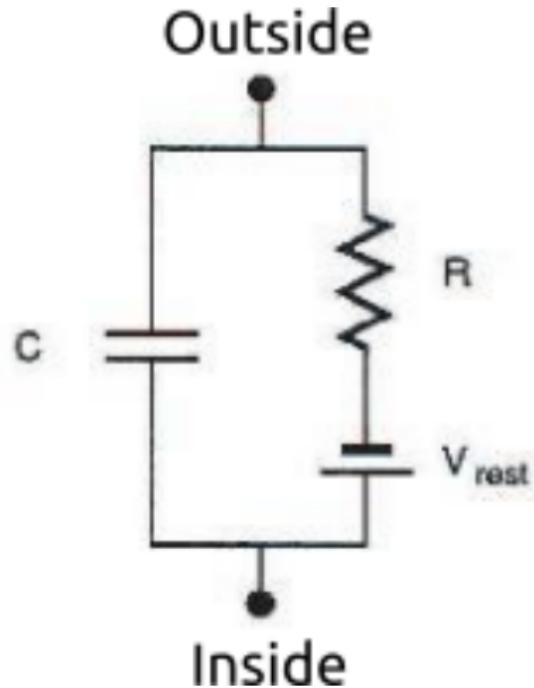
Ett nevron kan modeleres som en elektrisk krets



Ett nevron kan modeleres som en elektrisk krets



Ett nevron kan modeleres som en elektrisk krets



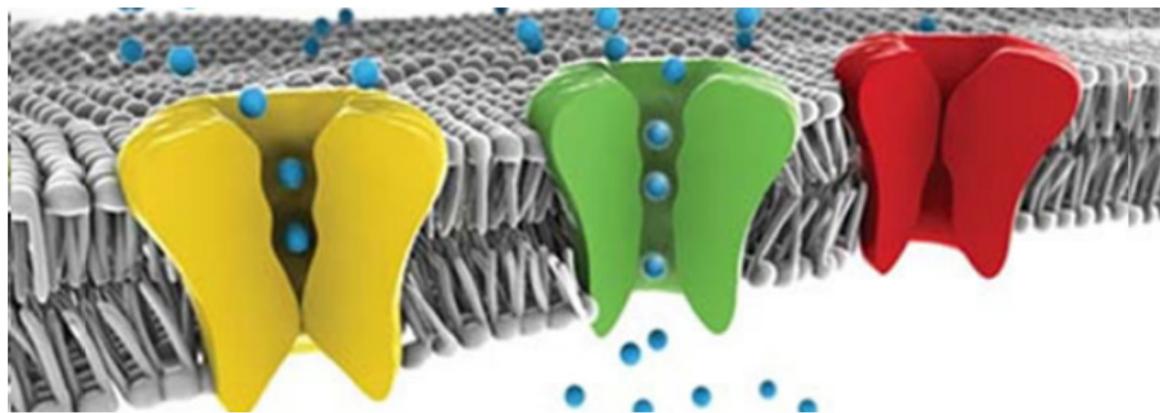
$$I = C \frac{dV}{dt} + I_{\text{kanaler}}$$

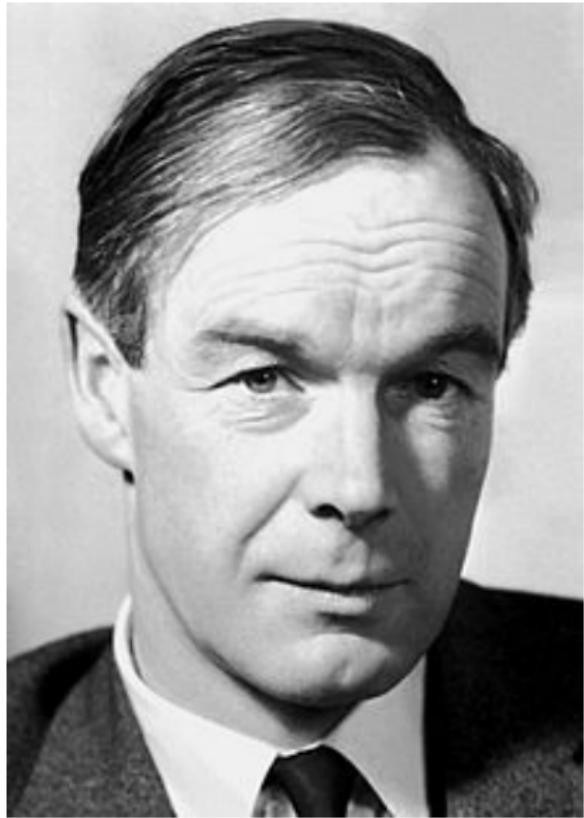
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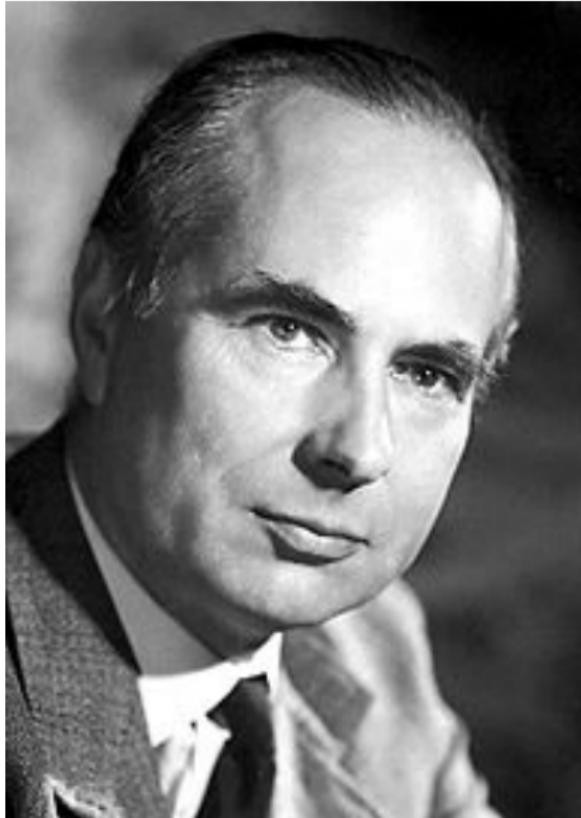
Ett nevron kan modeleres som en elektrisk krets

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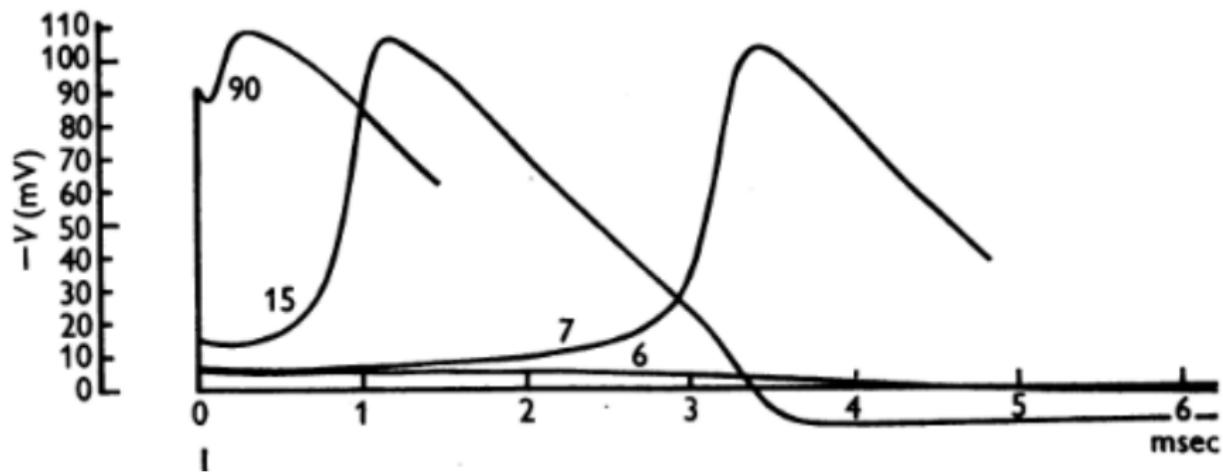


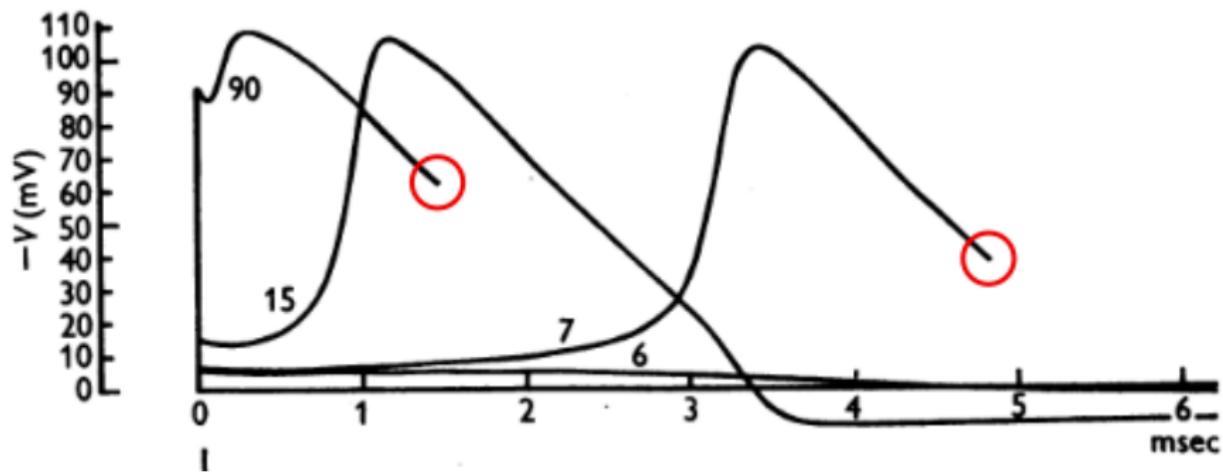


Alan Lloyd Hodgkin



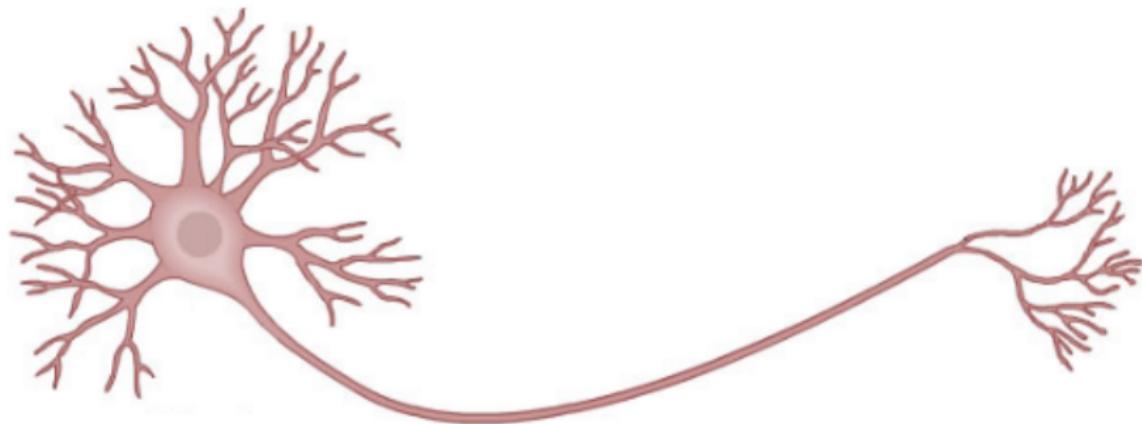
Andrew Fielding Huxley







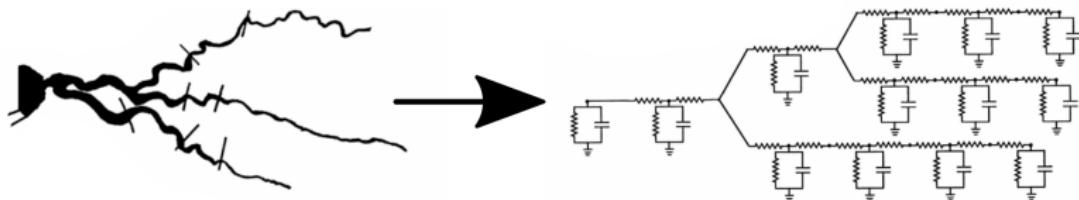




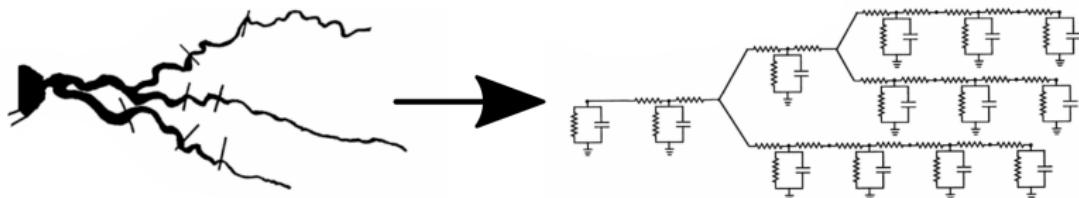
Mange kretser kan settes sammen til et nevron med utstrekning



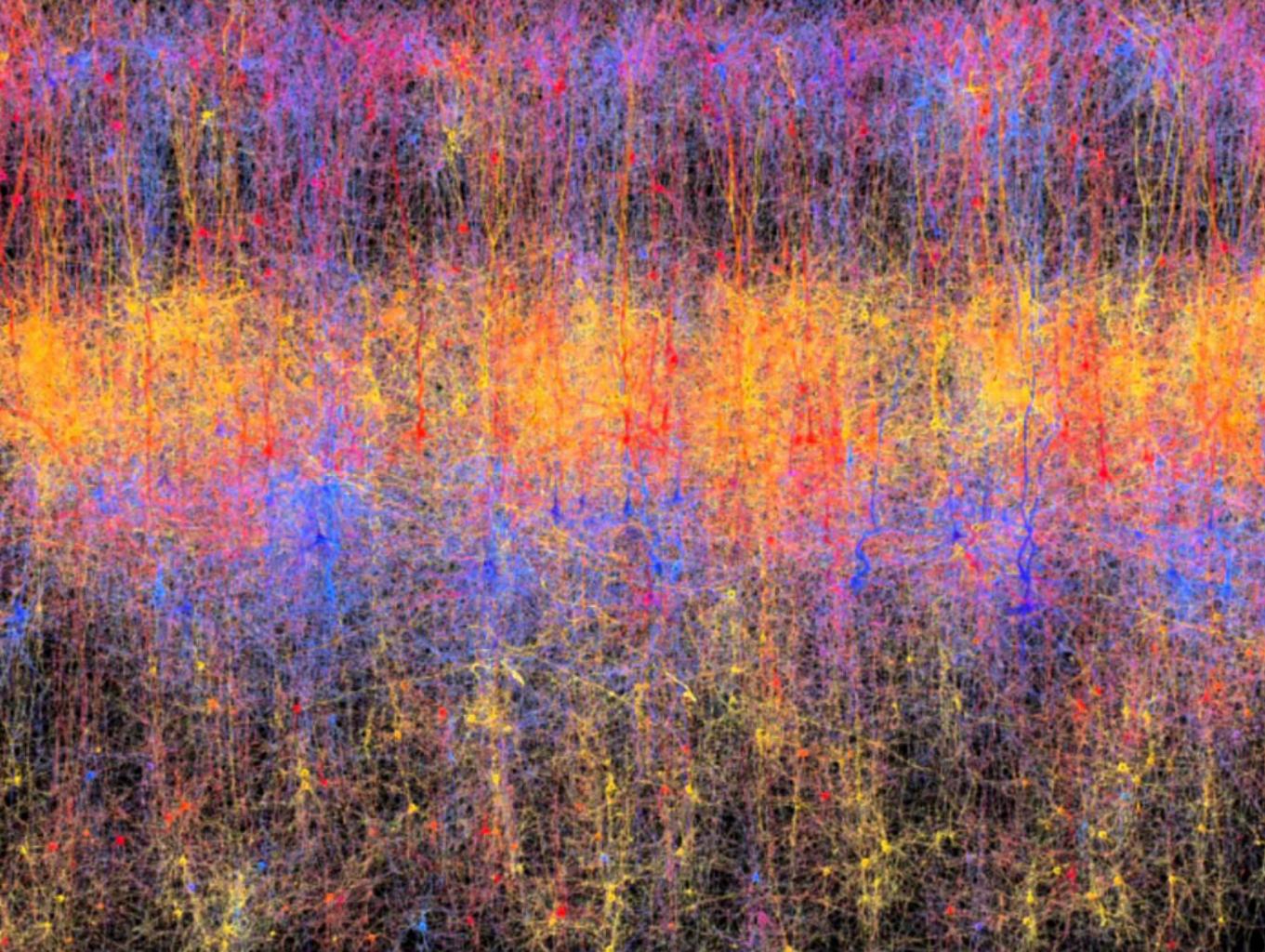
Mange kretser kan settes sammen til et nevron med utstrekning



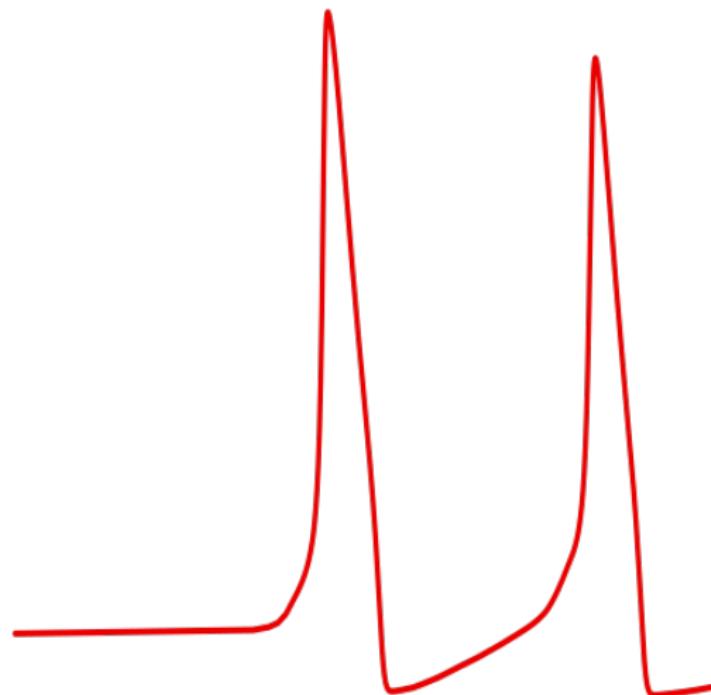
Mange kretser kan settes sammen til et nevron med utstrekning



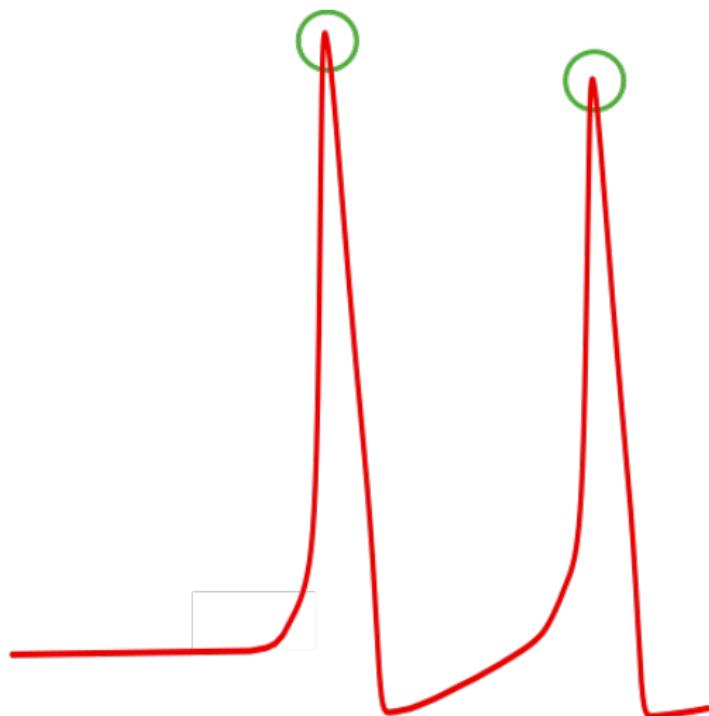
$$C_m \frac{dV_j}{dt} = -\sum_k I_{i,k,j} + \frac{d}{4R_a} \frac{V_{j+1} - V_j}{l^2} + \frac{d}{4R_a} \frac{V_{j-1} - V_j}{l^2} + \frac{I_{e,j}}{\pi d l}$$



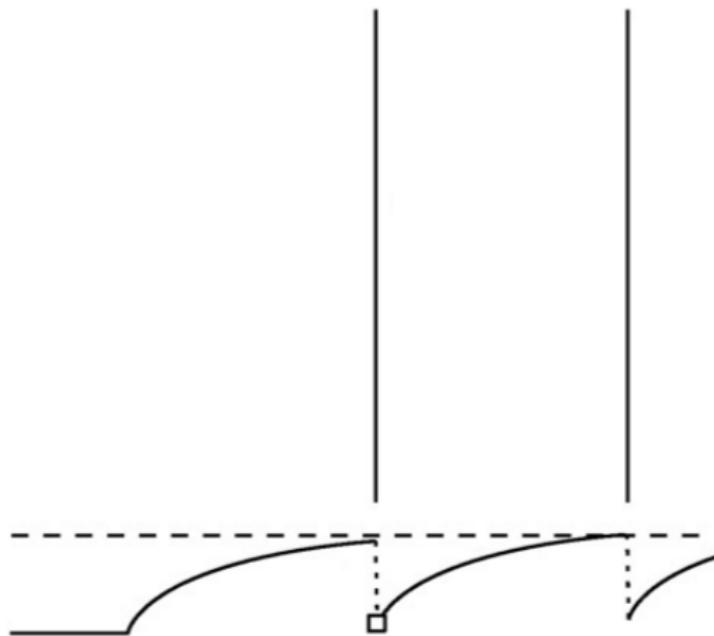
Realistiske nevroner krever tunge beregninger, i
nettverk brukes derfor ofte enklere modeller



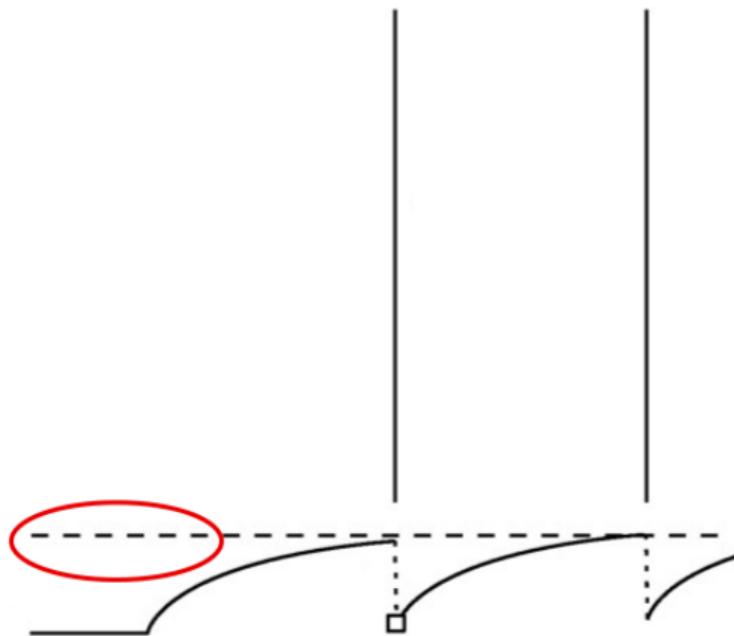
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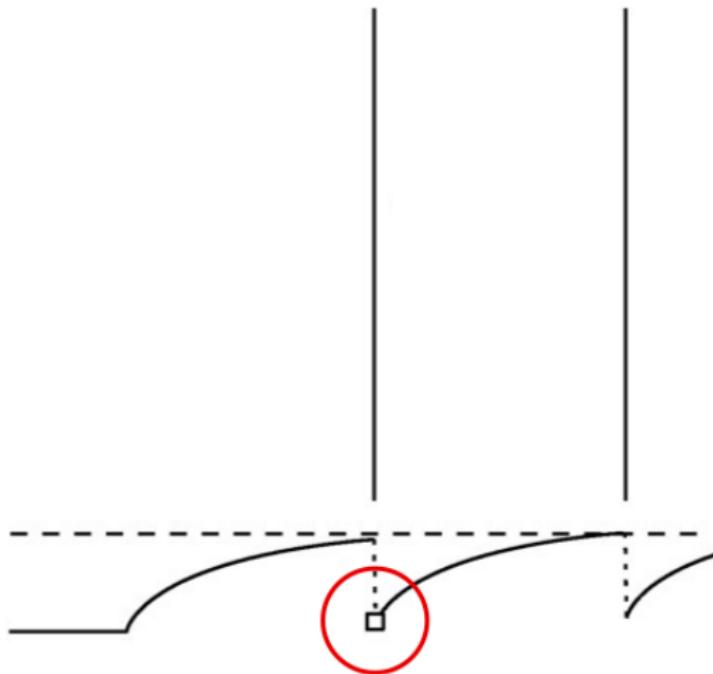
Realistiske nevroner krever tunge beregninger, i
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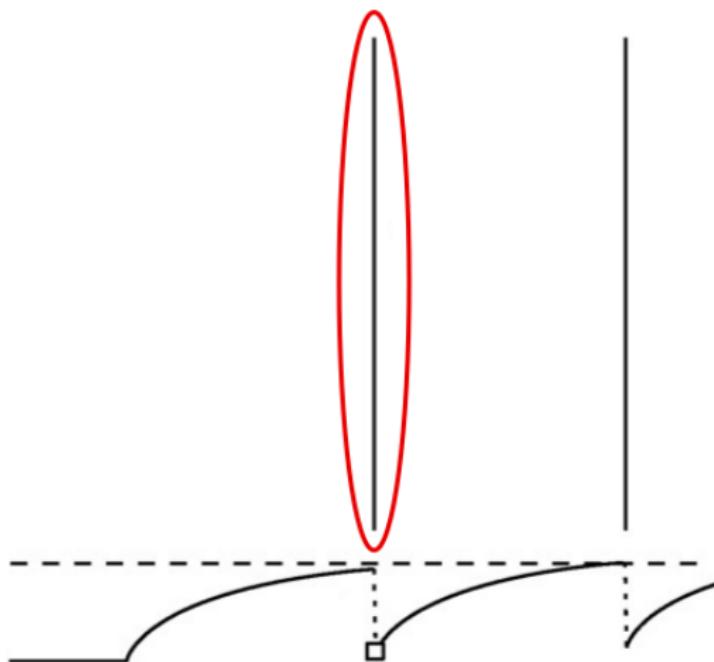
Realistiske nevroner krever tunge beregninger, i
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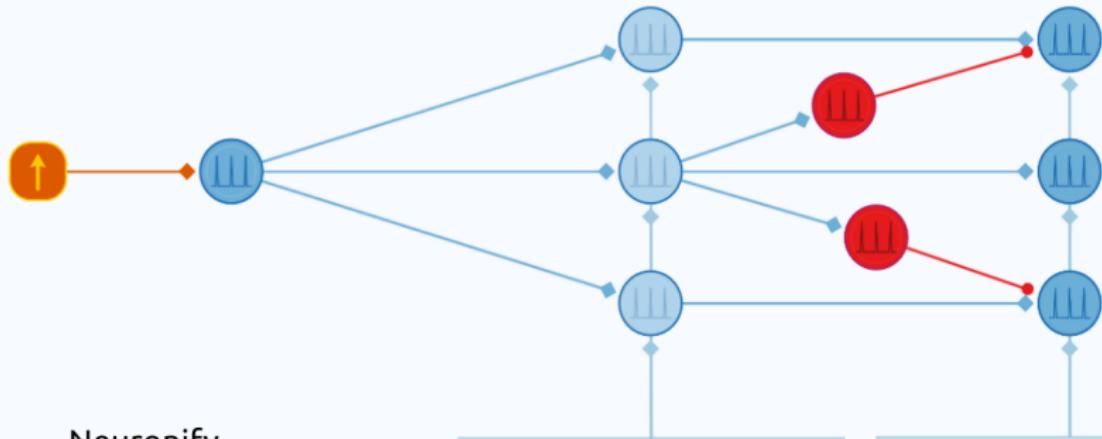


Realistiske nevroner krever tunge beregninger, i
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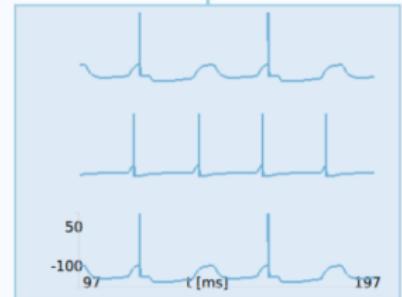
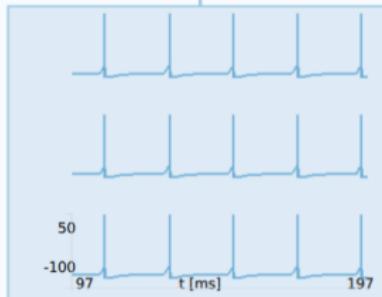


Realistiske nevroner krever tunge beregninger, i
nettverk brukes derfor ofte enklere modeller





Neuronify





Grunnlegende nevrovitenskap

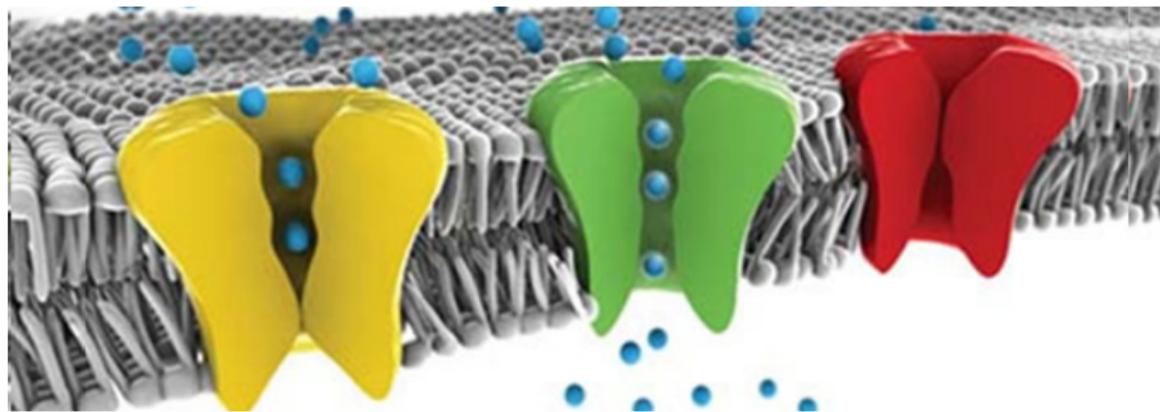


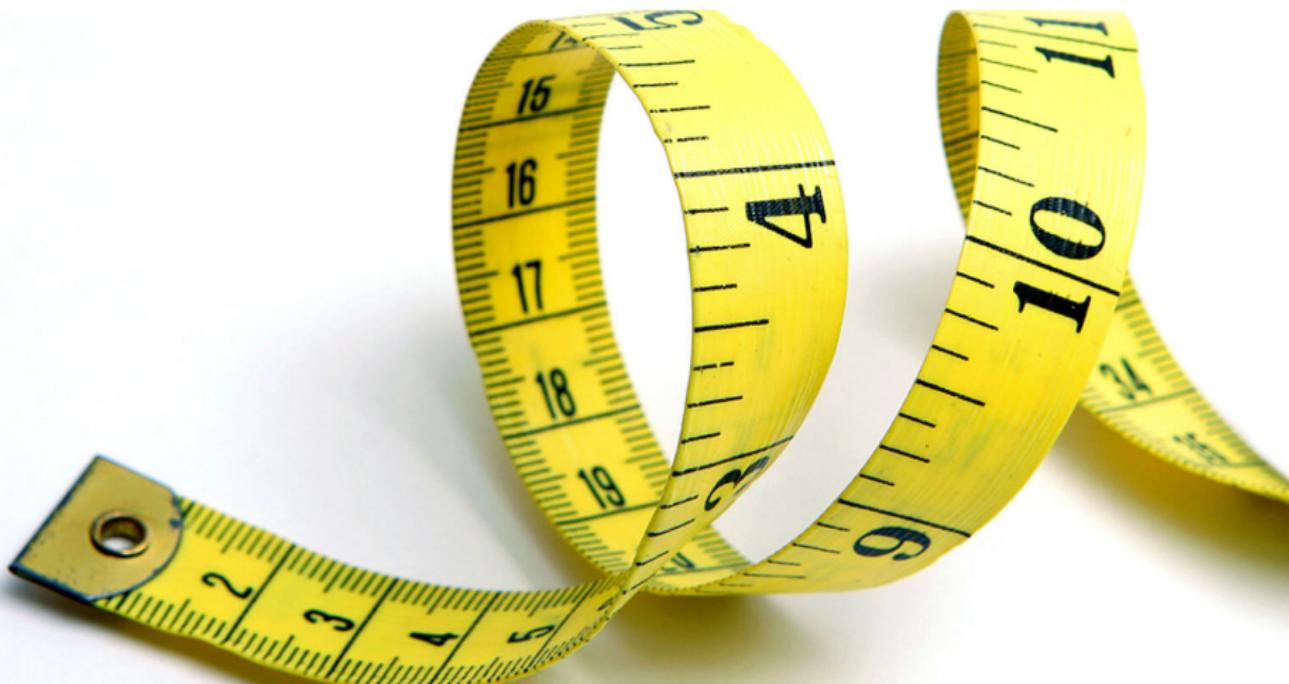
Beregningsorientert nevrovitenskap

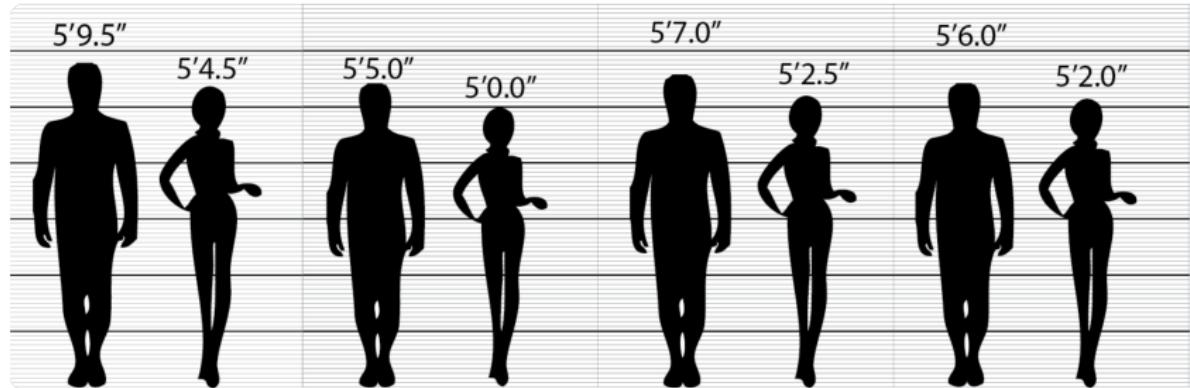


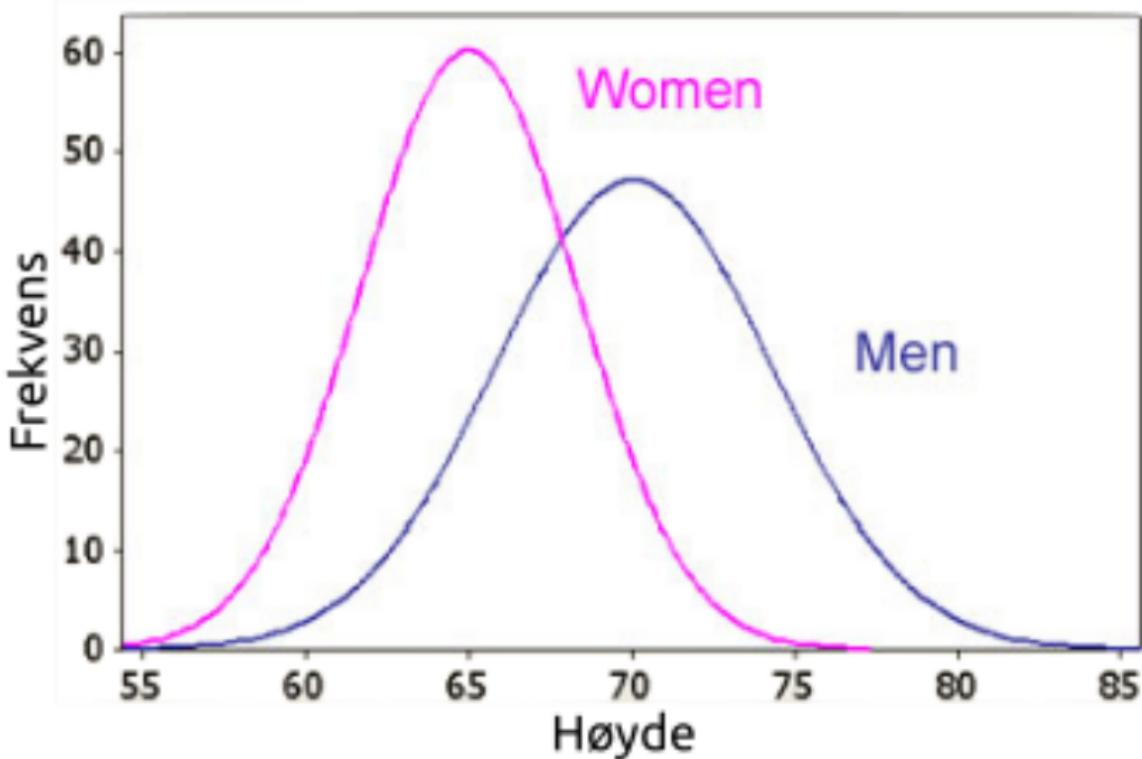
Usikkerhet i nevrovitenskap

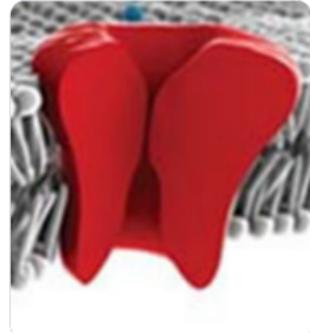
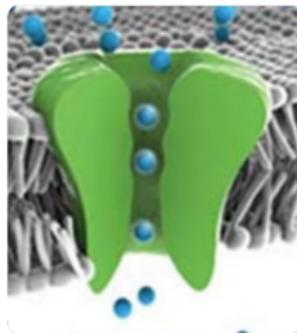
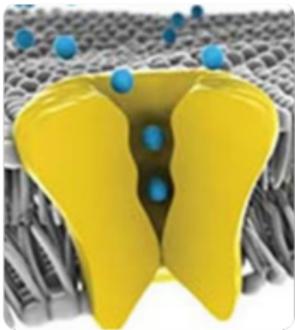
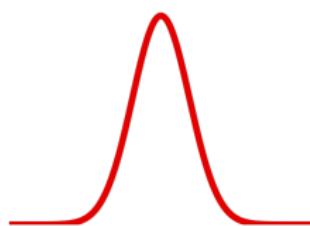
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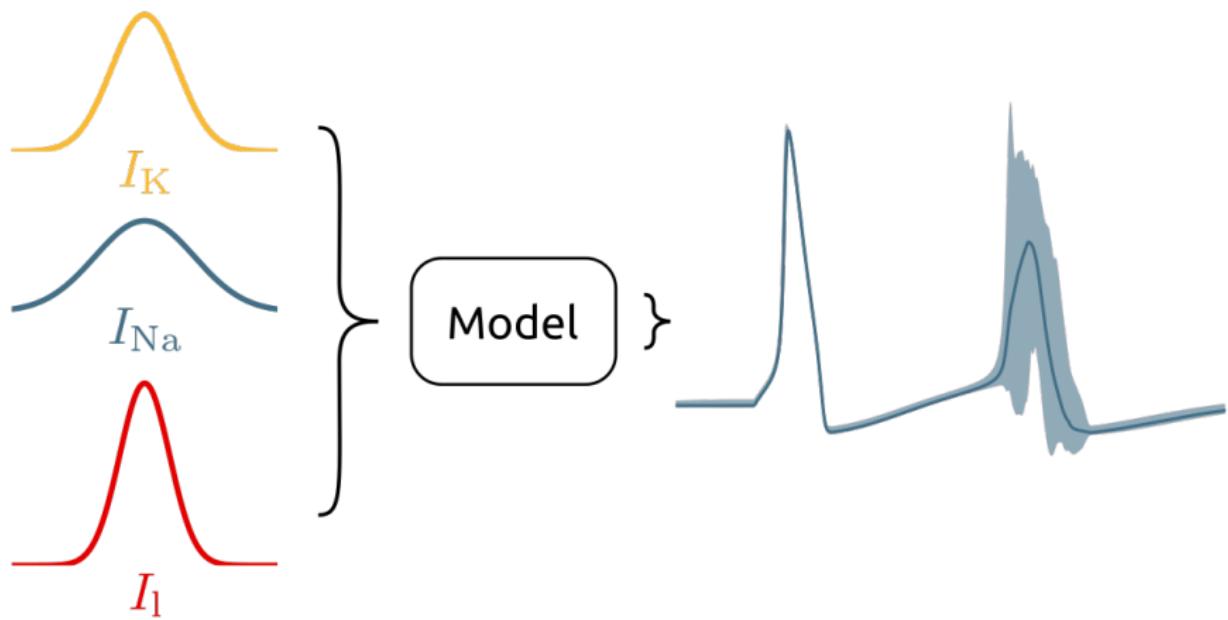


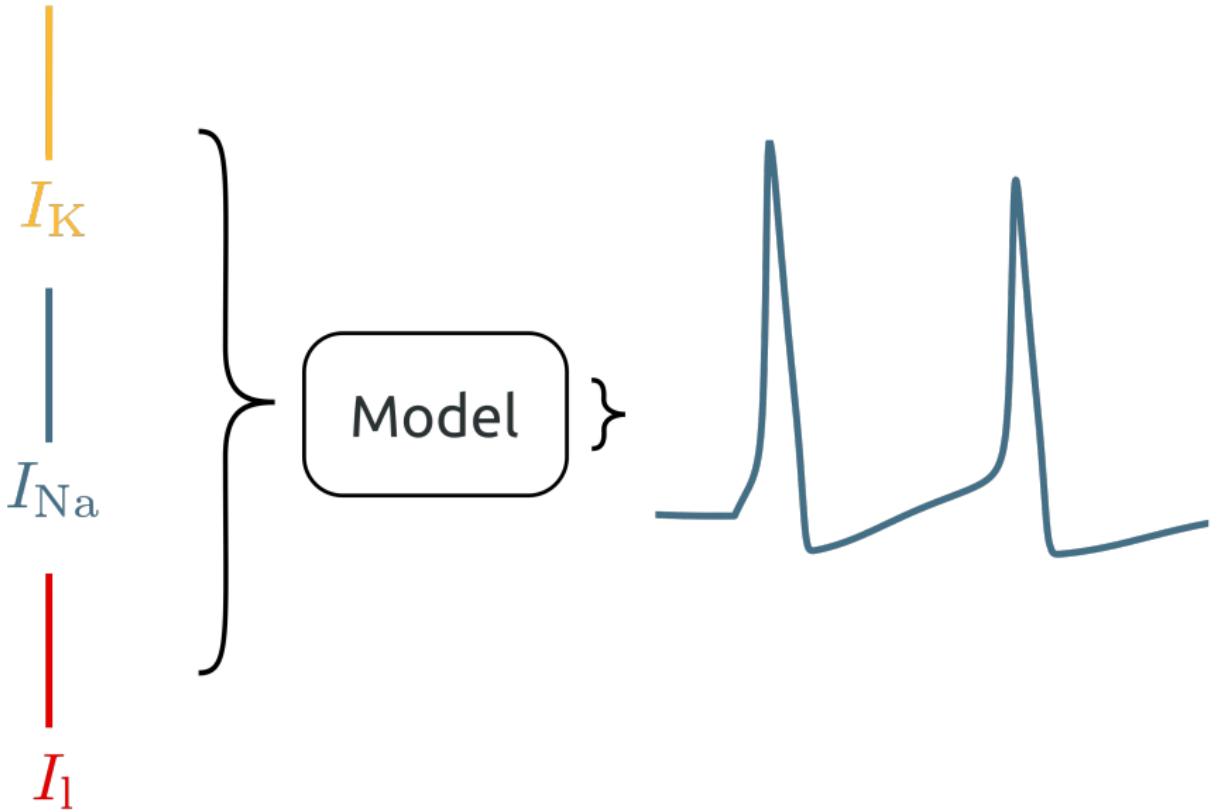


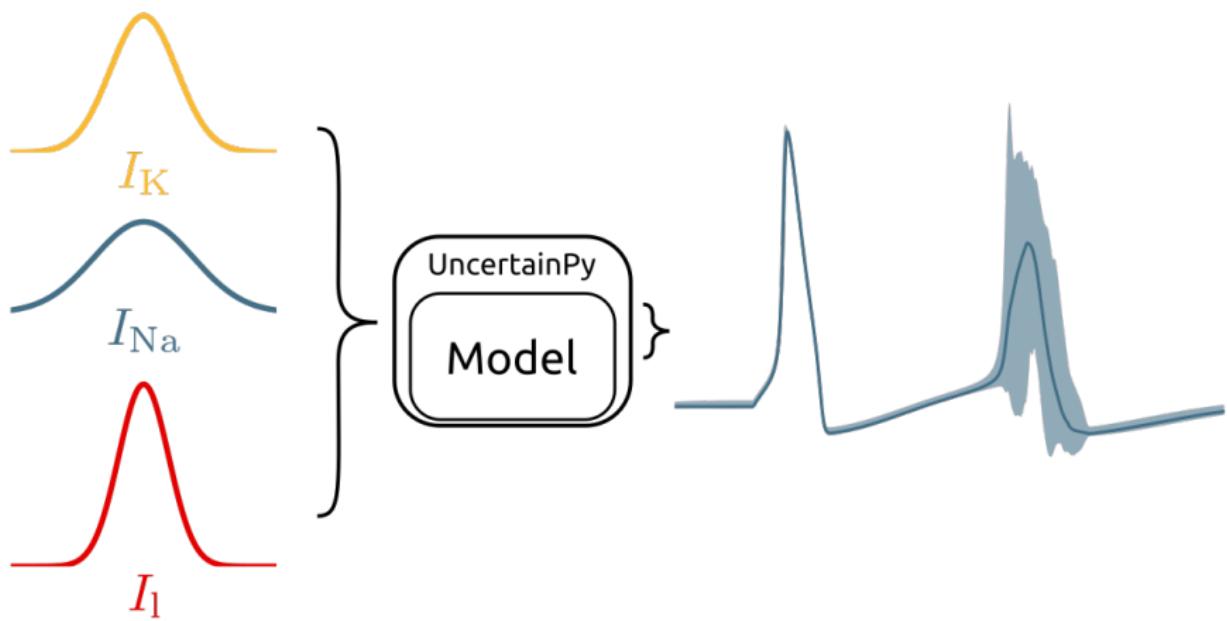




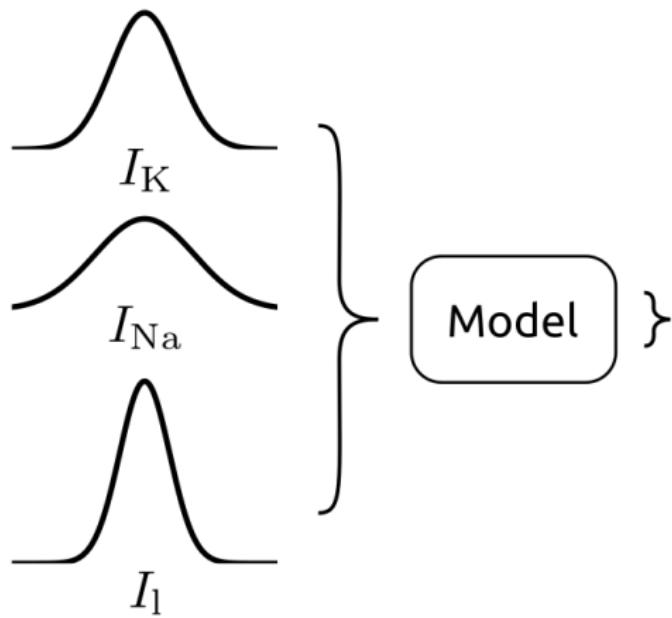
 I_K  I_{Na}  I_l

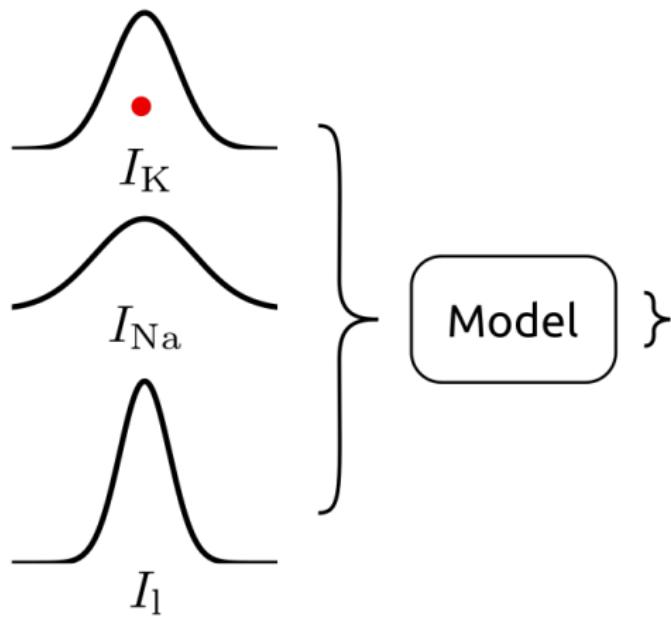


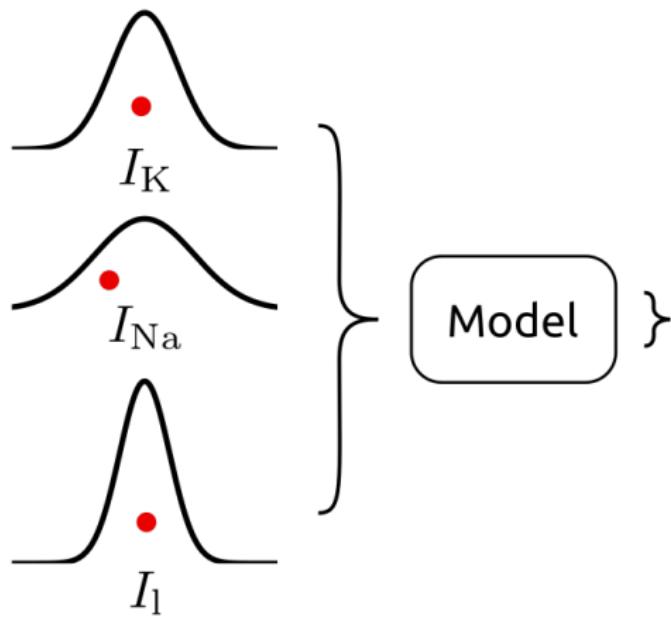


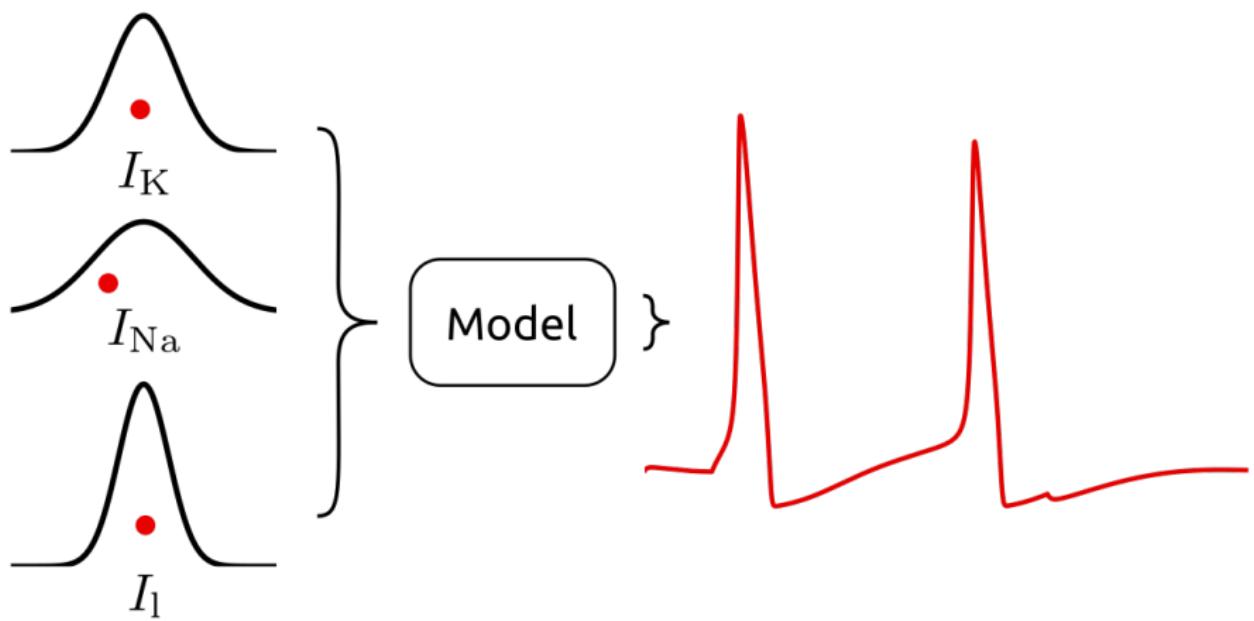


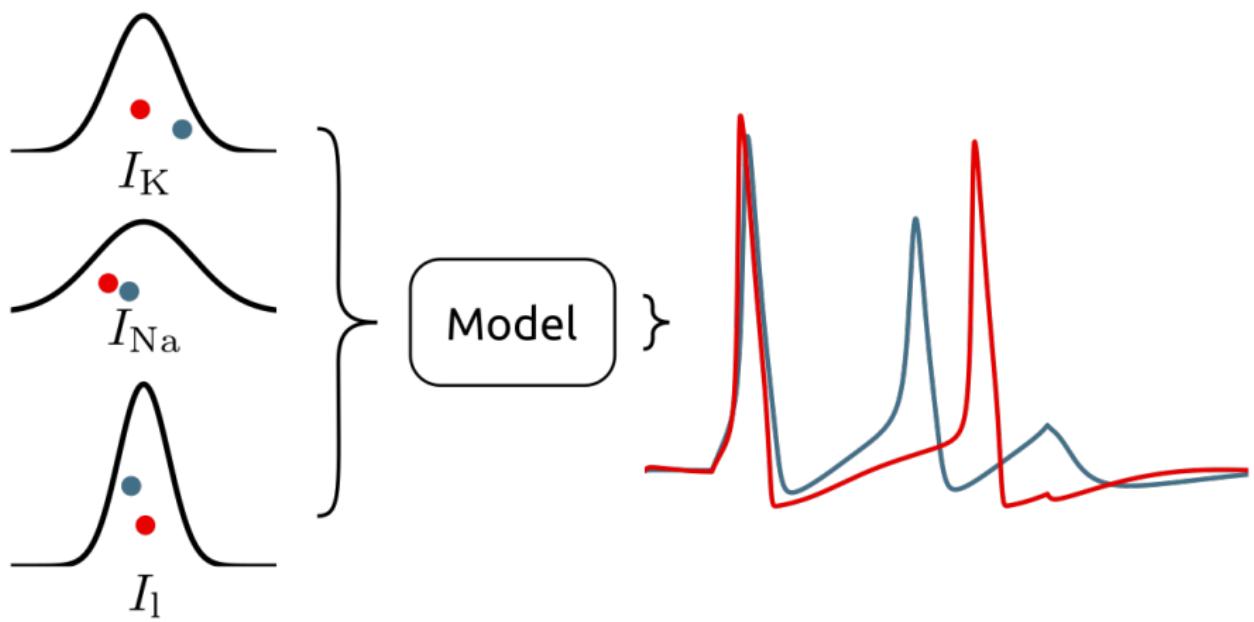


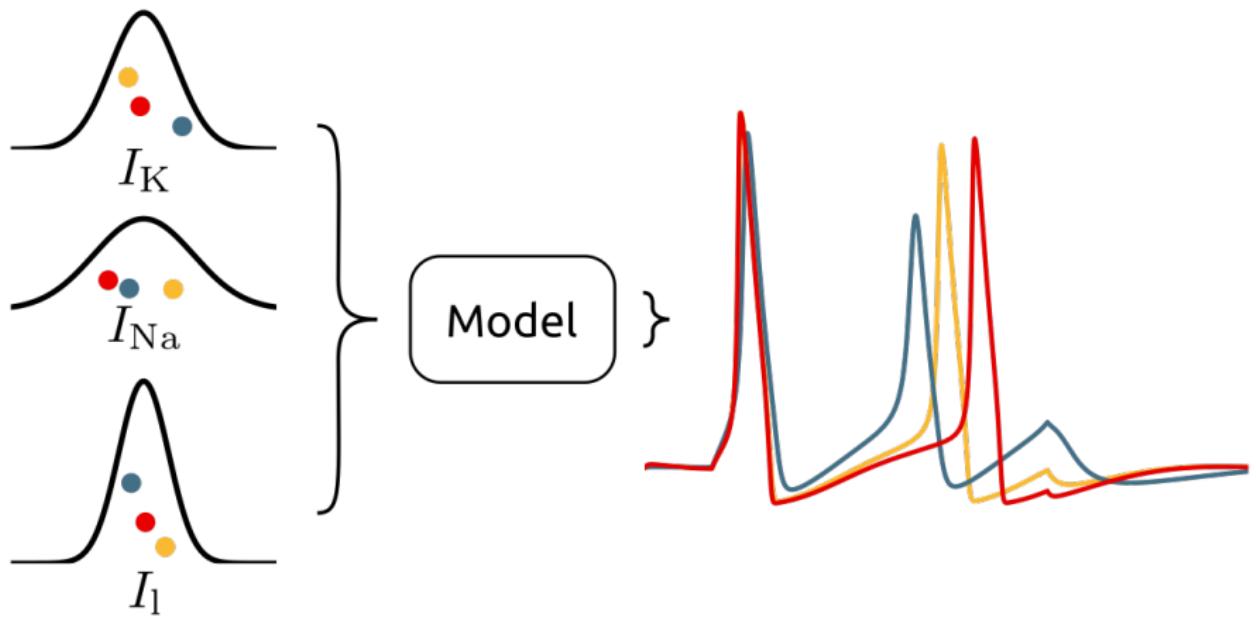




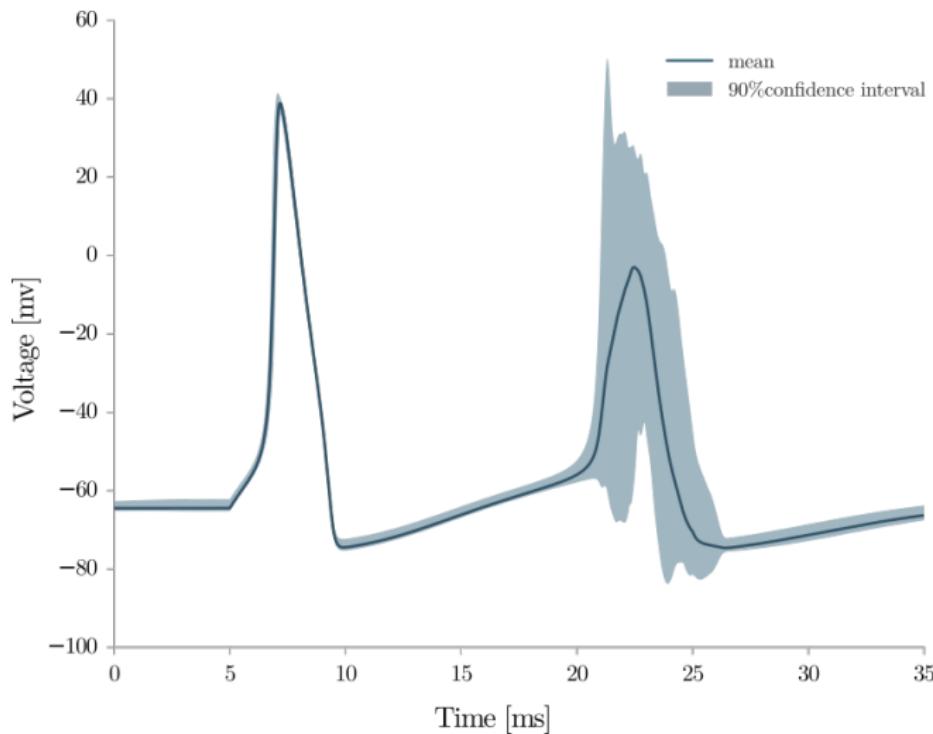




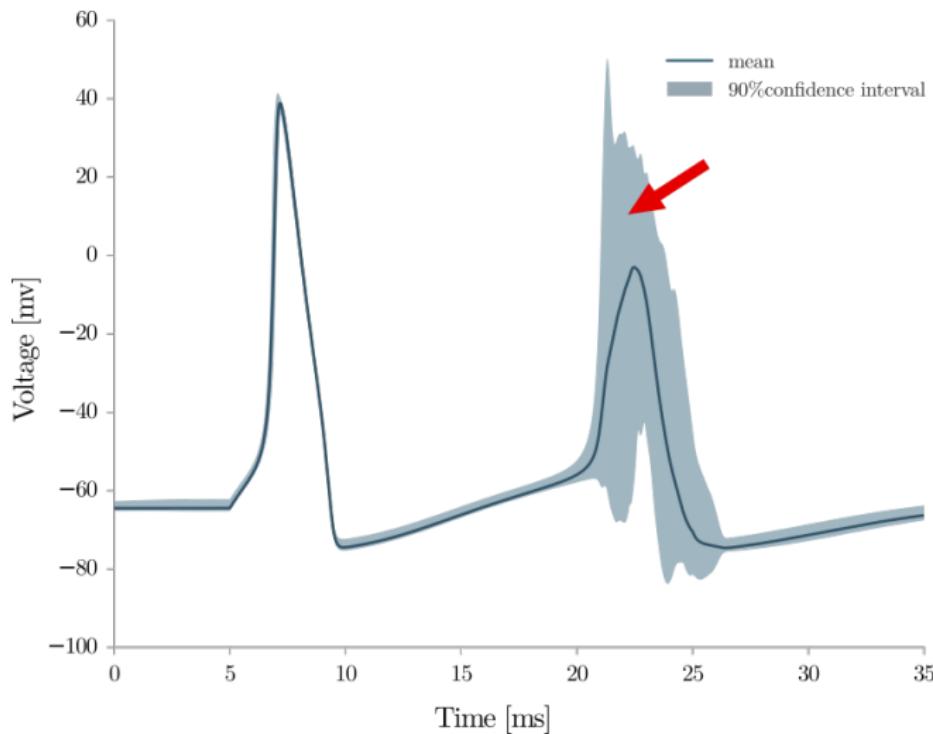




Resultat: Usikkerhet i aksjonspotensialet (90% konfidensintervall)

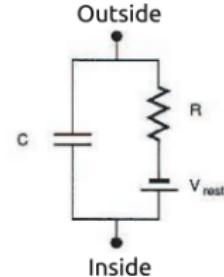


Resultat: Usikkerhet i aksjonspotensialet (90% konfidensintervall)



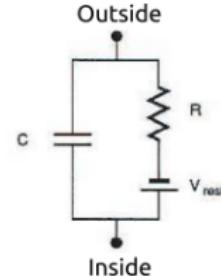
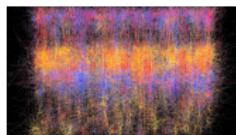
Oppsummering

Nevroner kan modeleres som elektriske kretser



Oppsummering

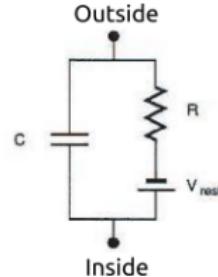
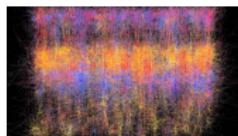
Nevroner kan modeleres som elektriske kretser



Slike nevroner kan kobles sammen i nettverk

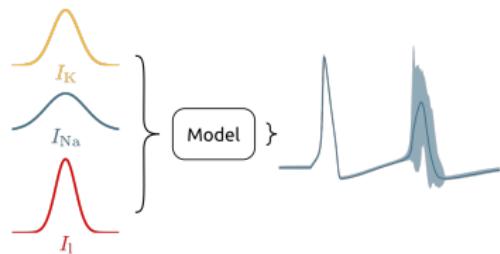
Oppsummering

Nevroner kan modeleres som elektriske kretser



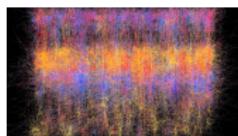
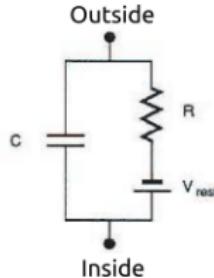
Slike nevroner kan kobles sammen i nettverk

Usikkerhetsberegninger tar hensyn til variable biologiske parametere



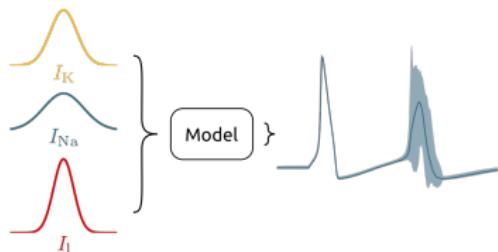
Oppsummering

Nevroner kan modeleres som elektriske kretser



Slike nevroner kan kobles sammen i nettverk

Usikkerhetsberegninger tar hensyn til variable biologiske parametere



Takk for meg!