1) Forward methods: solve $f(x) = 0$

or $\frac{d^2y}{dx^2} = g(y, x)$ – BVP → discretized $f(y) = 0$

Newton method, extended Newton's method, Halley's method.

2) Inverse methods: $\min f(\theta)$ → Gauss Newton method
Halley's method inspired
corrected Gauss Newton method.

3) Linking FE Models
Differential equations w/ parameters
a) Coding from scratch
b) FEBio ✓ → user.
c) FEniCS ✓ → developer
d) Deal II

Start w/ 1D BVP.

Grading rubric

$f(u) = 0$

$\epsilon = \frac{dy}{dx}$

$Ku = f$

$x \to \tau(x)$
$\tau[f(x)] = 0$
$\tau(x)\, f(x) = 0$

⇒ Large deformation elasticity

✓ ⇒ CHAME paper → forward motivation.
✓ ⇒ BMMB // → inverse "

Numerical optimization by