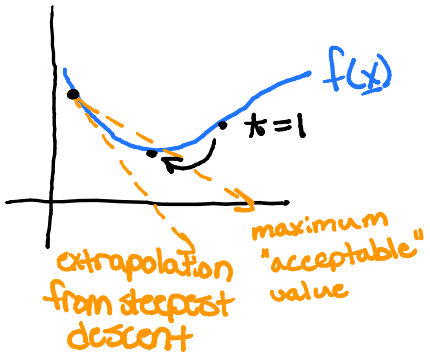
PHYS 177
winter 2019

lecture 16 : line search

learning goals
- apply simple line search heuristics

steepest descent can suggest a direction, but how far to go? with steepest descent no natural scale for t

backtracking line search



choose parameters $\alpha \in (0, 1/2)$, $\beta \in (0,1)$

initialize $t = 1$

while $f(\underline{x} + t\underline{s}) > f(\underline{x}) + \alpha t \nabla f(\underline{x})^T \underline{s}$

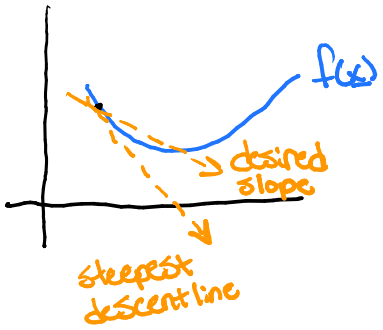
$t = \beta t$

start w/ "large" step, step back until decrease of function is acceptable

typically α is small ($\sim 10^{-3}$) and $\beta \in (0.1, 0.8)$

backtracking line search ensures sufficient decrease
if $f(\underline{x})$ does not decrease enough, then step is not accepted

curvature condition



sufficient decrease is always satisfied if steps are very small

to guard against too small steps, we can also introduce a curvature condition

$$\nabla f(\underline{x} + t\underline{s})^T \underline{s} \geq \gamma \nabla f(\underline{x})^T \underline{s}$$

with $\gamma \in (\alpha, 1)$ (typically $\gamma \in (0.1, 0.9)$)

this ensures that derivative is decreasing as well

* notebook example "correcting" previous bad steps, introduce unbalanced quadratic to motivate Newton's method