

Unit 4: Optimization with Calculus

KEY

SA	could be used as a stand alone lesson, provided prior knowledge is met
Time	approximate # of 45-50 min periods
Coding	These lessons are geared towards Julia; lessons will need modification for other languages. “Coding” includes: basic commands, loops, if/else.
C+L	Computer with desired language installed
SC/GC	Scientific/Graphing calculator
(T)	May need extra time for tech troubleshooting

Title	Topics	Prior knowledge	Equipment	Sequence	Slides	Practice Problems	Time
4.1 nderivs	<ul style="list-style-type: none">challenges for programmersdefinition of derivativewriting a derivative program	<ul style="list-style-type: none">derivativescoding	C+L	SA	15	3	1.5
4.2 Simpson integrals	<ul style="list-style-type: none">Simpson’s Rule integral approximationwriting an integral program	<ul style="list-style-type: none">integralscoding	C+L	SA	17	5	2
4.3 Newton	<ul style="list-style-type: none">Newton’s methodwriting a root-finding program	<ul style="list-style-type: none">derivativescoding	C+L	4.1	7	2	1.5
4.4 packages and sawtooth	<ul style="list-style-type: none">downloading packages for Juliacalculating maximum slope for sawtooth	<ul style="list-style-type: none">derivativescoding	C+L +internet	2.8, 4.1-2	16	3	2 (T)
4.5 curve sketching	<ul style="list-style-type: none">first and second derivatives in curve sketchingwriting a program to analyze graph shape	<ul style="list-style-type: none">derivativescoding	C+L	SA (+ calculus package)	7	4	2
4.6 concavity verification	<ul style="list-style-type: none">using concavity to verify max/minwriting a program to report max/min using concavity	<ul style="list-style-type: none">derivativescoding	C+L	4.5	6	1	1
4.7 gradients	<ul style="list-style-type: none">meaning of a gradientfinding a gradient	<ul style="list-style-type: none">derivatives	0	SA	15	5	1.5
4.8 applications of gradients	<ul style="list-style-type: none">evaluating gradientsgraphical applications of gradient	<ul style="list-style-type: none">derivatives	0	4.7	12	6	2
4.9 finding Hessians	<ul style="list-style-type: none">finding a Hessiansymmetry of Hessians	<ul style="list-style-type: none">derivatives	0	4.7	8	3	1
4.10 applications of Hessians	<ul style="list-style-type: none">determinantseigenvalues (by hand, with computer)concavity implications of eigenvalues	<ul style="list-style-type: none">derivatives	C+L	4.9	18	6	2
4.11 gradient 1 (steepest)	<ul style="list-style-type: none">using Calculus package for gradients, Hessianssteepest descent minimization	<ul style="list-style-type: none">derivatives	C+L	2.4, 4.7-4.10	16	6	2
4.12 gradient 2 (conj grad)	<ul style="list-style-type: none">meaning of conjugate gradientconjugate gradient minimization	<ul style="list-style-type: none">derivatives	C+L	4.11	14	5	2
4.13 extensions	<ul style="list-style-type: none">maximizingglobalbeyond 3D	<ul style="list-style-type: none">derivatives	C+L	4.7-4.12	7	3	1

Total time, not including assessment/extra: 21.5 days