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Prof. Little
Math 136
2 April 2014

with(*DEtools*);

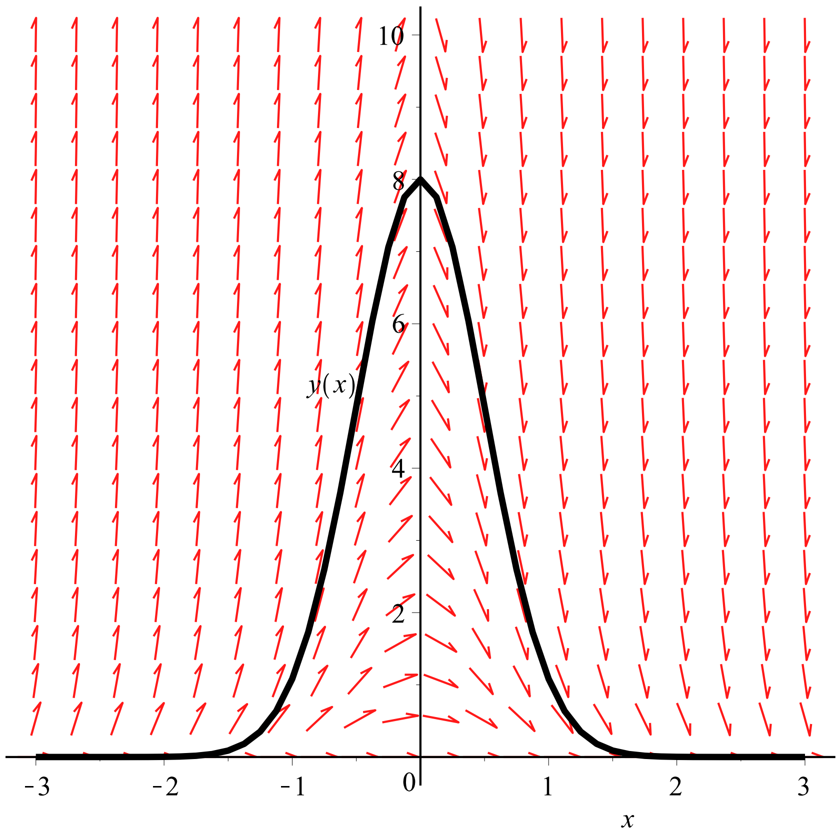
[*AreSimilar*, *Closure*, *DEnormal*, *DEplot*, *DEplot3d*, *DEplot_polygon*, *DFactor*, *DFactorLCLM*, *DFactorsols*, *Dchangevar*, *Desingularize*, *FunctionDecomposition*, *GCRD*, *Gosper*, *Heunsols*, *Homomorphisms*, *IVPsol*, *IsHyperexponential*, *LCLM*, *MeijerGsols*, *MultiplicativeDecomposition*, *ODEInvariants*, *PDEchangecoords*, *PolynomialNormalForm*, *RationalCanonicalForm*, *ReduceHyperexp*, *RiemannPsols*, *Xchange*, *Xcommutator*, *Xgauge*, *Zeilberger*, *abelsol*, *adjoint*, *autonomous*, *bernoullisol*, *buildsol*, *buildsym*, *canoni*, *caseplot*, *casesplit*, *checkrank*, *chinisol*, *clairautsol*, *constcoeffsols*, *convertAlg*, *convertsys*, *dalembertsol*, *dcoeffs*, *de2diffop*, *dfieldplot*, *diff_table*, *diffop2de*, *dperiodic_sols*, *dpolyform*, *dsubs*, *eigenring*, *endomorphism_charpoly*, *equinv*, *eta_k*, *eulersols*, *exactsol*, *expsols*, *exterior_power*, *firint*, *firtest*, *formal_sol*, *gen_exp*, *generate_ic*, *genhomosol*, *gensys*, *hamilton_eqs*, *hypergeomsols*, *hyperode*, *indicialeq*, *infgen*, *initialdata*, *integrate_sols*, *intfactor*, *invariants*, *kovacicsols*, *leftdivision*, *liesol*, *line_int*, *linearsol*, *matrixDE*, *matrix_riccati*, *maxdimsystems*, *moser_reduce*, *muchange*, *mult*, *mutest*, *newton_polygon*, *normalG2*, *ode_int_y*, *ode_y1*, *odeadvisor*, *odepde*, *parametricsol*, *particularsol*, *phaseportrait*, *poincare*, *polysols*, *power_equivalent*, *rational_equivalent*, *ratsols*, *redode*, *reduceOrder*, *reduce_order*, *regular_parts*, *regularsp*, *remove_RootOf*, *riccati_system*, *riccatisol*, *rifread*, *rifsimp*, *rightdivision*, *rtaylor*, *separablesol*, *singularities*, *solve_group*, *super_reduce*, *symgen*, *symmetric_power*, *symmetric_product*, *symtest*, *transinv*, *translate*, *untranslate*, *varparam*, *zoom*]

with(*plots*);

[*animate*, *animate3d*, *animatecurve*, *arrow*, *changecoords*, *complexplot*, *complexplot3d*, *conformal*, *conformal3d*, *contourplot*, *contourplot3d*, *coordplot*, *coordplot3d*, *densityplot*, *display*, *dualaxisplot*, *fieldplot*, *fieldplot3d*, *gradplot*, *gradplot3d*, *implicitplot*, *implicitplot3d*, *inequal*, *interactive*, *interactiveparams*, *intersectplot*, *listcontplot*, *listcontplot3d*, *listdensityplot*, *listplot*, *listplot3d*, *loglogplot*, *logplot*, *matrixplot*, *multiple*, *odeplot*, *pareto*, *plotcompare*, *pointplot*, *pointplot3d*, *polarplot*, *polygonplot*, *polygonplot3d*, *polyhedra_supported*, *polyhedraplot*, *rootlocus*, *semilogplot*, *setcolors*, *setoptions*, *setoptions3d*, *spacecurve*, *sparsematrixplot*, *surfdata*, *textplot*, *textplot3d*, *tubeplot*] **(2)**

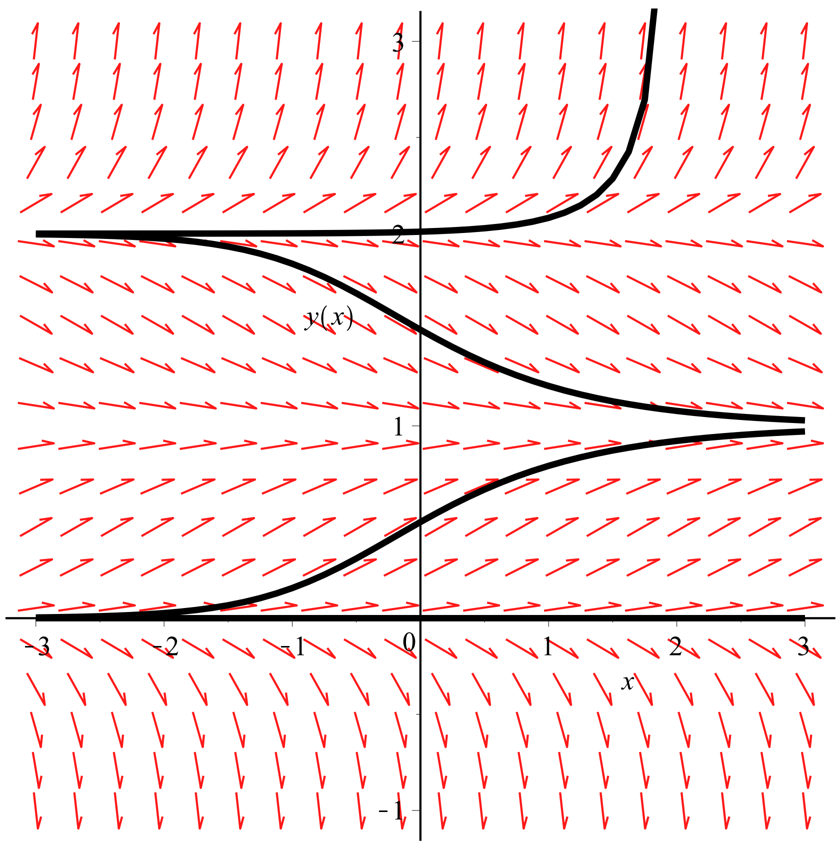
I.A)

$DEplot(diff(y(x), x) = -4\,x \cdot y(x), y(x), x = -3..3, [y(0) = 8], y = 0..10, linecolor = black);$



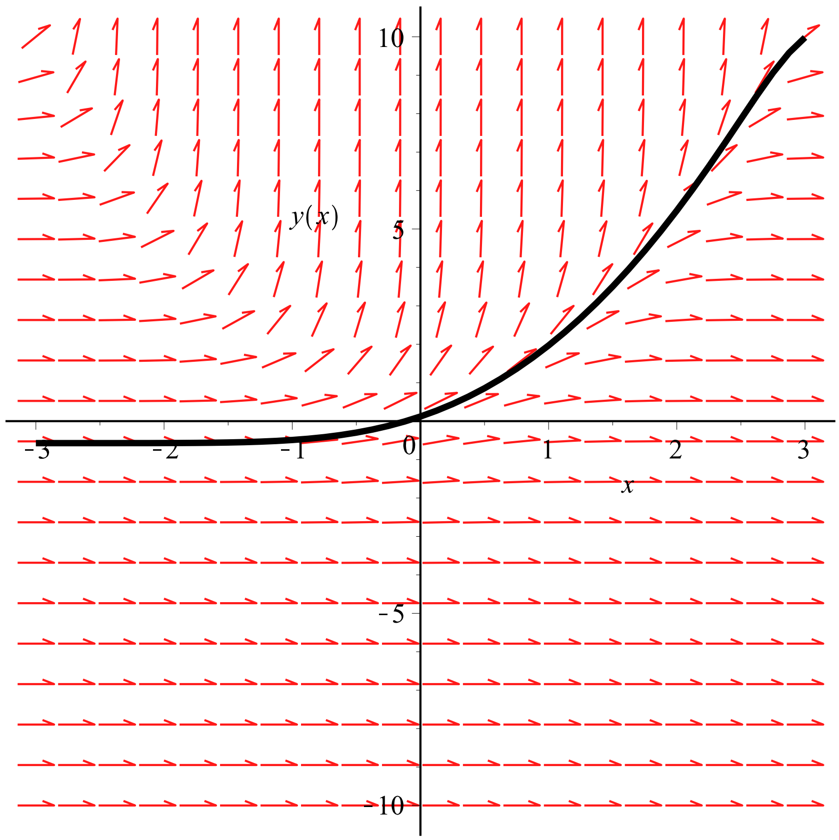
I.B)

DEplot(*diff* ($y(x)$, x) $= y(x) \cdot (y(x) - 1) \cdot (y(x) - 2)$, $y(x)$, $x = -3 ..3$, [$y(0) = 0$, $y(0) = 0.5$, $y(0) = 1.5$, $y(0) = 2.01$], $y = -1 ..3$, *linecolor* = *black*);



I.C)

$DEplot\left(diff\left(y(x), x\right) = \exp\left(-x^2 + y(x)\right), y(x), x = -3..3, \left[y(-3) = -.572369\right], y = -10..10, linecolor = black\right);$



II.D) Yes because if one looks at the slope fields of A, B and C, one can see that they all have asymptopes where f '(x) of the differential equation=0 (AKA where f '(x)switches from positive to negative or vice versa) and therefore, one can see the gerenal shape of the graph.

II.E) The cut off value is approximately −.572369. So y_0 >= −.572369 will aprroach a limit of infinity.

III.A)

$xl[0] := 0 : yl[0] := 8 :$
for i **to** 4 **do**
$xl[i] := xl[i-1] + .25;$
$yl[i] := yl[i-1] - 4\, xl[i-1] \cdot yl[i-1] \cdot (0.25);$
end do;

0.25

8.

0.50

6.0000

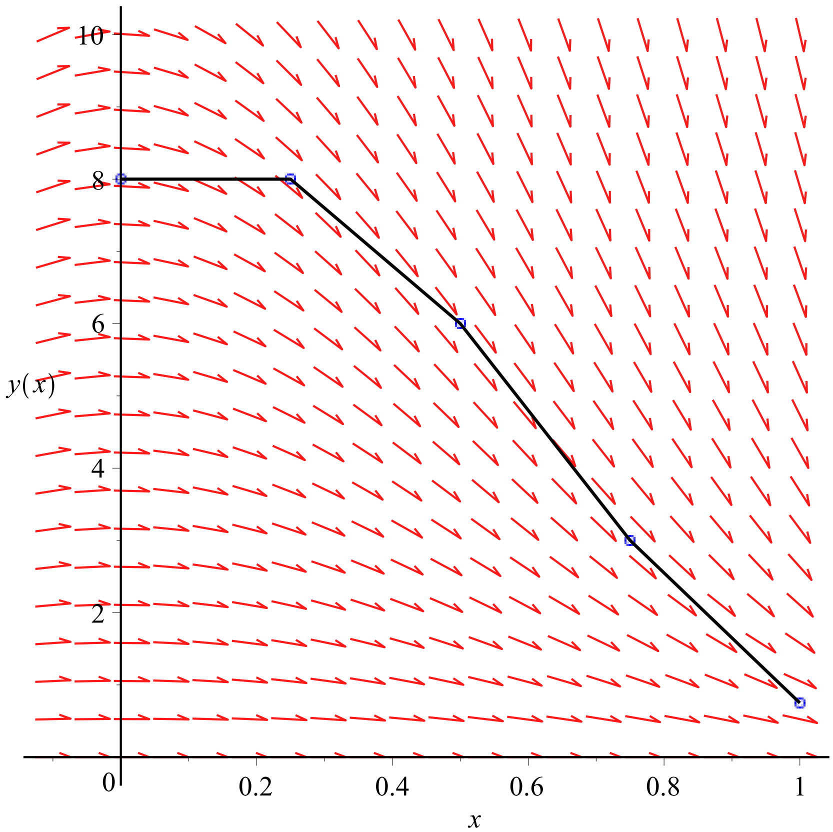
0.75

3.00000000

1.00

$$0.750000000 \tag{3}$$

$DirField := DEplot(diff(y(x), x) = -4 \cdot x \cdot y(x), [y(x)], x = -.1..1, y = 0..10)$:
$Pts := plot([seq([xl[i], yl[i]], i = 0..4)], style = point, symbol = circle, color = blue)$:
$Lines := plot([seq([xl[i], yl[i]], i = 0..4)], color = black)$:
$display(DirField, Pts, Lines)$;



III.B)
$xl[0] := 0 : yl[0] := 8$:
for i **to** 4 **do**
$xl[i] := xl[i-1] + 0.05$;
$yl[i] := yl[i-1] - 4\, xl[i-1] \cdot yl[i-1] \cdot (0.05)$;
end do;

$$0.05$$

$$8.$$

$$0.10$$

$$7.9200$$

$$0.15$$

$$7.76160000$$

$$0.20$$

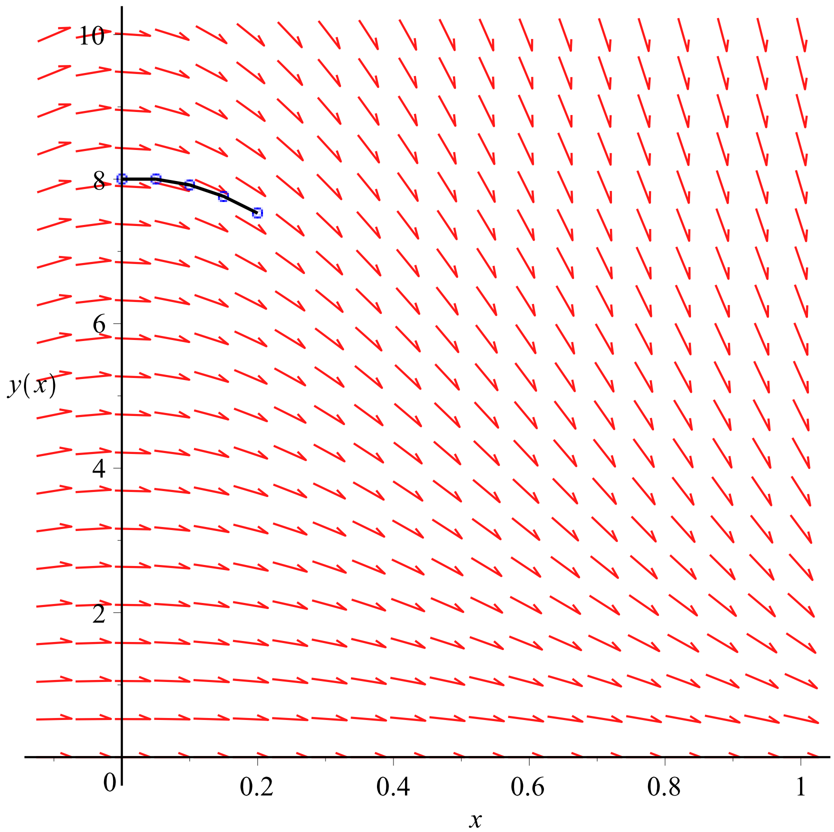
$$7.528752000 \qquad (4)$$

$DirField := DEplot(diff(y(x), x) = -4 \cdot x \cdot y(x), [y(x)], x = -.1 ..1, y = 0 ..10):$

$Pts := plot([seq([xl[i], yl[i]], i = 0 ..4)], style = point, symbol = circle, color = blue):$

$Lines := plot([seq([xl[i], yl[i]], i = 0 ..4)], color = black):$

$display(DirField, Pts, Lines);$



III.C) It seems like the pattern is every odd i there is an underestimate. The property of the line givern by Euler's method which indicates that it is an underestimate is when it is below the corresponding points given by the slope field and when it's above those slope field points there is an overestimate indicated. See graphs in III.A and III.B for illustration of these properties.