MATH 2413 Fall 2012, Lectures 31–33

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Outline of Sections 4.7–5.1

1. General procedure to solve an optimization problem;
2. General form of optimization problems;
3. Anti-derivatives; The most general anti-derivative;
4. First derivative test for global max/min;
5. 

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\int 1 \, dx = x + C
\]
\[
\int e^x \, dx = e^x + C
\]
\[
\int \cos x \, dx = \sin x + C
\]
\[
\int \sec^2 x \, dx = \tan x + C
\]
\[
\int \sec x \tan x \, dx = \frac{1}{\cos x} + C
\]
\[
\int \frac{1}{\sqrt{1-x^2}} \, dx = \arcsin x + C
\]
\[
\int x^n \, dx = \frac{1}{n+1} x^{n+1} + C
\]
\[
\int \frac{1}{x} \, dx = \ln |x| + C
\]
\[
\int \sin x \, dx = -\cos x + C
\]
\[
\int \csc^2 x \, dx = -\cot x + C
\]
\[
\int \csc x \cot x \, dx = -\frac{1}{\sin x} + C
\]
\[
\int \frac{1}{1+x^2} \, dx = \arctan x + C
\]
Outline of Sections 4.7–5.1

1. Finite sum approximation of the area or net area of the region between the graph of $y = f(x), a \leq x \leq b$ and the $x$-axis.
2. Partition of the interval $[a, b]$; step size; representation of partitioning points; sample points;
3. Upper sum/lower sum;
4. sigma notation and its basic properties.
Exercises:

1. Give an example function which has local maximum and local minimum but no absolute maximum and minimum;

2. Consider a differentiable function \( y = f(x), x \in (a, b) \). Is it true that if there exists a global maximum, then it must also be a local maximum?

3. Consider a differentiable function \( y = f(x), x \in (a, b) \). If we don’t know whether or not a global maximum exists, can we search among the local maximums of \( f \) to determine its global maximum?

4. Consider \( y = x^3, x \in [-1, 1] \). Partition the interval \([-1, 1]\) into \(2n\) intervals with equal length. Find the partitioning points and write the finite sum approximation of the net area of the region between \( f \) and the \( x \)-axis, using rectangles with height equal to the function value at the right end point of each of the sub-intervals.