TI Nspire CAS Primer

This "primer" will provide you with a quick introduction to the TI Nspire CAS. Read it with a calculator in hand and practice!

Before you use it:

1. **Batteries**. If you have not purchased the square rechargeable battery, you are using **four AAA batteries**. To change these, slide over the button on the back of the calculator, and slip off the key board. Install. Press the **home** icon to get to the home screen. On the upper left, there is a little battery depicted to remind you of the power available.
2. **Contrast**. To increase or decrease contrast, press the control key (**ctrl**) and either (+) or (-), plus or minus, to increase or decrease contrast.
3. **Restoring Defaults**. To reset the calculator to factory defaults, press the **home** icon on the upper right, select **Settings** with the cursor and **enter** key, select **Handheld Setup**, cursor down and select **Restore,** then select **ok**. Back in **Settings,** you can select **Document Settings**, and then **Restore** for more factory settings restored.
4. Use the escape key **esc** to exit a menu.

MODE

When you set the mode of your calculator, you tell it how to handle numbers (exact or approximate), what angles to use (radian or degree), etc.

1. Press the **home** icon on the upper right, select **settings** with cursor and **enter** key, select **Document Settings**.

2. To start, see if settings are the following. If not, you may want to change some of them:
   Display digits- Float 6
   Angle- Radian
   Exact/Approx- Auto (cursor down to find this)

   Note: **Restore** will automatically use these settings.

3. About **Exact/Approx**. In the **AUTO** mode, the calculator does exact arithmetic by keeping fractions, radicals, logs, etc., in symbolic instead of decimal form when it can. For instance, to enter $\sqrt{2}$ press **ctrl x²** on the double black button on the left and then 2. The calculator will return $\sqrt{2}$. But if you press **ctrl enter,** the calculator will return the decimal approximation. Also, if you enter a number with a decimal point, such as (2/5.), a decimal approximation will be returned.

ARITHMETIC

To use the TI Nspire as a calculator, press the home button and select **Scratchpad** . You can also press the button with the picture of the **calculator** on it. It's under the **esc** key. If a graph comes up, press it again. It toggles between graph and calculator.

1. The number "-8" (negative 8) is entered with the **negation** key**"(-)"**. To do the subtraction, 2 - 8, use the subtraction key on the double black button on the right. To obtain the answer -6, press the enter key. **The negation key and the subtraction key are not interchangeable.** Experiment to find out how the nSpire interprets your commands. (e.g. 2(-)2 returns -4, not 0, even though no multiplication sign was entered.)

Note: Pressing **ctrl clear** removes all data from the entry line.

2. The computer uses the **standard order of operations**.

3. To use **standard functions** like sine, cosine and log, we enter the function name first and then the number to be evaluated, just as you would write them. To find the trig functions, press the **trig** button on the left. A menu will appear. The log and exponential functions are on the keyboard.

4. Other functions are accessed from the **Catalog.** It is accessed from the button with **book** on it, next to the number 9. Press the first letter of the function you want to speed your search. Syntax appears at the bottom. (The comma is way down on the alphabet keyboard.)

5. We can **edit** an arithmetic expression with the **cursor** keys and the delete arrow ←, on the right below **menu**. If the unevaluated (meaning you have not pressed enter) expression 2×3/5+7 must be **changed** to 2×4/5-7, move the blinking cursor bar until it is to the right of 3, and press ← to delete the 3 to the left of the bar.

6. After you press **enter**, the calculator returns an empty line. To return a previously entered expression for evaluation or editing, cursor up to it, and press **enter**, and it will appear in the new line.

7. The calculator stores the result of your last calculation as "Ans". If you use an operation like *3, it will return Ans*3. So if Ans = 6 from your last computation, entering *3will return 18. If you want to evaluate sin(Ans), press sin(**ctrl (-))**.

8. You can **cut and paste** an expression from any line. Cursor up to highlight the expression, then press **ctrl c.** Then cursor down to your computation line and press **ctrl v**.
9. To **store** an answer to a memory location, press **sto,** i.e. **ctrl var**. What you will see "ans$\rightarrow$". You can place your answer to a variable that is a string of letters and symbols (starting with a letter) unless that string is protected. If you want to store 8.33 to q, place 8.33 on the entry line, press **sto,** then press q.

10. To clear stored variables, go to **menu,** select **actions,** and then select **clear a..z** to clear ALL of them, or **Delete Variable (***your variable)* to clear just one variable. **This is very IMPORTANT!!**

Exercises

1. Evaluate the following expressions. Note that the number pi is entered just that way, from the alphabet keyboard or you can select it from the menu that appears next to the letter h.

a) 2/7 + 3.117 b) $\frac{2+3.117}{7}$ c) -5 + 33/π d) 5-23/(7x4.3)

e) 39^2 f) $\sqrt{9.33476}$ g) 4.233^{-1} h) $3.7^{\frac{6}{7}}$

i) $4.8^{-4/5}$ j) tan(2.35x5.67) k) $(-2.7)^{2/3}$ l) $\left(\sin\left(2\pi-\sqrt{2}\right)\right)^{4/5}$

2. Enter $2+\frac{3}{5\pi}$ and evaluate the expression. Recall it for editing. Change the 3 to 7 and evaluate. Recall the last expression, delete π, and evaluate.

3.
a. Enter $2\times(3.117)^{5/3}-17$ and evaluate. Recall the expression for editing. Insert a factor of -2.71 to obtain $2\times(-2.17)\times(3.117)^{5/3}-17$. Evaluate.

b. Store your answer in a variable w.

c. Evaluate π^3 and multiply it by the number in w.

4.

a. Evaluate sin(23°), changing mode if necessary. Change the back to radian measure and evaluate $\sin\left(\frac{3\pi}{17}\right)$ and $\frac{\sin(3\pi)}{17}$.

b. Evaluate $\cos(3.2^2)$. Use "Ans" to evaluate $\ln(\cos(3.2^2))$ without typing cos.

GRAPHING

There are lots of ways to do this. Here are two of them.

0. Go to the **home** page, cursor to Documents. Select **New Document**, then select **Add Graph.**

OR,

On the **home** page, select the graph icon from the bottom set of icons.

1. An axis appears. You enter the function to be graphed in the bottom space labeled *fn(x)* . If the space is not there, press the **tab** button. Enter your expression, and press **enter**. (Variables are on the keyboard.) It will graph your function in a default window.

2. **Graphing more than one function.** Press **tab** to get another line for your next function and enter it. Both will be graphed. To see a list of your functions, use the right cursor to highlight the right arrows on the right of the entry line. Hit **enter**. All will appear. Cursor up and down to select the line you want to edit. By highlighting the **checked box**, and hitting **enter**, the check disappears and the function will not be graphed. Doing the same to the unchecked box enable the function to be graphed. It toggles.

3. To save your graph for later use, press the **doc** button, select **File**, then select **save** or **save as.** You will be prompted for a file name. Enter it.

4. To access a saved file, press **doc,** then **My Documents,** then **MyLib.** A list of saved documents will appear. Select and enter.

Most of the rest of what we do with graphs accessed through the **menu** button.

5. **The WINDOW.** Press the **menu** button, select **Window/Zoom,** then select **Window Settings.** Enter the size of your window as usual. Explore the various zoom options.

6. **Trace.** Press the **menu** button, select **trace,** then **Graph Trace**. You can move the tracer with the right-left cursors. The up-down cursor lets you change which function you are tracing. The coordinates of the tracer appear on the bottom right of the screen.

7. **Analyze Your Graph**. Press the **menu** button, select **Analyze Graph.** Lots of options become available. A brief look indicates that you can, for instance, find the maximum and minimum values over an interval, the roots (zeroes) of a function on an interval, the integral over an interval. For example, to find the root (or "zero" of a function) of a function, press the **menu** button, select **Analyze Graph,** then select **Zero**. If you have more than one function graphed, use the cursor or little mouse pad to point to and then select which function you want to find the root of. It will prompt you for a lower bound, then an upper bound for the interval in which to find the root. After you enter them, hit **enter** one more time. The root will appear. Other options work similarly. **Make sure you become thoroughly familiar with this menu!** Save your document if you wish to return to this worksheet.

8. **Piecewise functions.** To graph the function $f(x) = x^2$ for $x \geq 1$ and $f(x) = x - 1$ for $x < 1$, use the **piecewise** function available in the catalog (book icon). The syntax for this particular function is piecewise(x-1, x<1, x^2, x ≥1). You can find ≥, etc., above the equal sign on the left. (**ctrl =).**

9. **Making Tables**. To make a table of values of the functions displayed in a graph, press **menu**, select **table,** select **Split-Screen Table.** The table will appear. To adjust step size, values, etc., press **menu** and select **Table.** In that list, you can delete the table, edit expressions, and **Edit Table Settings.**

Exercises

1. Enter the following functions and graph them in the viewing window $-3 \leq x \leq 3, -10 \leq y \leq 10$:

f(x)=2x-3 g(x)= $x^2 - 4$ h(x)=sin(x)

a) Graph only f and g, then only f and h, and finally only g and h.

b) Use the tracer to estimate the points of intersection of f(x) and g(x). Zoom in to get a better approximation. Try boxing in the points of intersection. Repeat the process for the other points of intersection.

3. Graph $y1 = x^3 - 16x^2 + 70$ and $y2 = 10x^2$ on the same axis. Experiment with the viewing window until you see all the points of intersection. (How many do you expect?) Use **menu,** and then, **Analyze Graph,** to find the points of intersection and also to find the local minimum and maximum values and the zeros (roots) of y1.
4. Graph the function f(x) = $\begin{cases} x^3 - 1 & x > 1 \\ \text{abs}(x) & -1 \le x \le 1 \\ 1/x & x < 1 \end{cases}$ using the "piecewise" option and the catalog.
5. Make a table of values for the functions y = sin(x) and the function f(x) = $x - x^3/3 + x^5/5$ starting at x = 0 and incrementing by $\Delta x = .2$.

SYMBOLIC MANIPULATION

The principal difference between the CAS enabled calculator and others is its ability to manipulate expressions symbolically. In this section we give a brief overview of its many capacities, concentrating on the **Algebra** and **Calculus**. When you are in Scratchpad or calculator mode, you can find these options by pressing **menu** and selecting.

1. **Entering and evaluating expressions**. If the expression $x^3 - x + 1$ is on the entry line, we can store it to a variable name, say w, by simply pressing **sto** w. Alternatively, we can create a function, say c(x), by pressing **sto** c(x). To evaluate the expression at x = 3, we enter c(3). The response is 25."

   Alternatively, we can evaluate an expression like $x^2 + 1$ at 3 with the syntax x^2+1 |x=3. You can find the evaluation bar | by going pressing ctrl and then the catalog button (little open book).

2. **Using Solve**. Press menu, select **Algebra,** then select **Solve.** The **Solve** option will solve and expression for a designated variable. We must enter an equation and a variable: **Solve(equ, var).** For instance, to solve the $x^2+y*x+3x = 2$, for x, enter Solve ($x^2+y*x+3x = 2$,x) . The calculator returns: x = $\frac{\sqrt{y^2+6y+17} - y - 3}{2}$ or x = $-\left(\frac{\sqrt{y^2+6y+17} - y - 3}{2}\right)$. To solve for y, enter Solve ($x^2+y*x+3x = 2$,y), which returns y = $\frac{-(x^2+3x-2)}{x}$.

IMPORTANT!!!!!! You must use the multiplication sign between x and y. Otherwise the calculator will interpret the string xy as one variable, not two!!!!

3. **nSolve** (Numerical Solve) Often equations cannot be solved symbolically. To obtain a numerical approximation to a solution, use nSolve. It will return one solution from perhaps many. The syntax is nSolve(equation, var or variable guess). For instance, to find a root of $\sin(x^2)$ nearest x = 8, enter nSolve($\sin(x^2) = 0$, x = 8). The calculator returns 7.92665.

4. **Simultaneous equations**. In Algebra menu, select **Solve System of Equations**. Two options will appear, Solve System of Equations, or Solve System of Linear Equations. You will be prompted for input.

5. **The Calculus Menu.** The calculator can differentiate and integrate both symbolically and numerically

i. To **differentiate** xsin(x), press **menu,** select **Calculus**, then select Derivative. A template will appear. Enter the variable and then the function. For higher derivatives, put the order in as a power when you enter the variable. So for the second derivative of $f(x)$, enter $d(f(x))/dx^3$.

ii. To evaluate a derivative, select Derivative at a point. You will be prompted for both a function and a value. This can be recalled for editing if you want to change the point of evaluation.

iii. To find the integral of x*sin(x), go to the Calculus menu and select **Integral.** A template will appear. Ignore the positions for the limits of integration to return an indefinite integral. For example, enter ∫(x*sin(x) dx) and the calculator returns sin(x) – xcos(x), having done integration by parts brilliantly. To evaluate $\int_a^b f(x)dx$, fill in the limits on the template.

iv. Limits and other options work similarly.

Exercises:

1. Create the function $g(x) = x^3 - 1/x$. Evaluate it at x = 4.5. Compose it with the function y = cos(x).
2. Solve the expression $x^2 + 4xy + 4y^2 = 3$ for y.
3. Find a root of xsin(x/2) near x = 3.
4. Solve the set of expression $x^2 + 2y^2 = 9$ and $x + 2y = 1$ simultaneously.
5. Solve the linear system x + y + z = 1, x + 2y + z = 0, x – y + 2z = 2 using the simult option.
6. Use the **expand** command in the algebra menu F2 to find the coefficient on the cube term of $(3x - 2)^5$. Use **propFrac** to find the quotient and remainder when the polynomial $x^4 - x + 1$ is divided by $x^2 + 1$. (Be careful with parentheses and be careful interpreting the results.)

7. If you are acquainted with calculus already, find the value of the derivative of xsin(x) at x = 1 and find the value of the integral of $x^2\sin(2x)$ from 1 to 2.

There are other important options in the algebra and calculus menus. **EXPLORE and EXPERIMENT!**