Information file for using CAT
-version 2.0.0

CAT: Complex Analysis Tools is a strong package of functions that helps to solve problems in complex analysis. The functions in CAT have many possibilities for adjustments, e.g. most functions can show the used steps.

Installation of CAT:

Use TI-Connect http://education.ti.com/us/product/accessory/connectivity/features/software.html. Right click on the CAT group file, and in the context box click [Send To] → [Connected TI Device] → [Archive]. The size of CAT is 16,500 bit.

Notes on CAT:

- In CAT the letter i will always be read as ***i*** = $\sqrt{-1}$.
- In CAT a complex function is referred to as Z and Z = φ(var1,var2) + ***i****ψ(var1,var2) or just Z = φ + ***i****ψ – where φ and ψ are real functions.
- Many functions require that the Complex Format isn't set to REAL.
- CAT was developed in TI-BASIC on a Voyage 200 and it works with the TI89 and TI92+ calculators as well (AMS 2.09 recommended).
- In some cases you must underscore a variable, like x_ instead of x. Otherwise the variable will not be assumed complex! *This should not be necessary when using CAT functions*, but build-in functions such as limit() and conj() require underscored variables.
- CAT takes advantage of the Advanced Symbolic Management Standard (ASMS).

The functions of CAT:

cauriequ(Z) – Calculates the Caury-Riemanns equations:
Returns: true if the function is differentiable, otherwise false.

Returns – in show step mode: $\begin{bmatrix} \varphi & \frac{d\varphi}{d\,\text{var1}} & \frac{d\psi}{d\,\text{var2}} & \frac{d\varphi}{d\,\text{var1}} = \frac{d\psi}{d\,\text{var2}} \Rightarrow \\ \psi & \frac{d\varphi}{d\,\text{var2}} & \frac{d\psi}{d\,\text{var1}} & -\frac{d\varphi}{d\,\text{var2}} = \frac{d\psi}{d\,\text{var1}} \Rightarrow \end{bmatrix}$

tanalyt(Z) – Tests if the complex function Z is analytical:
Returns: the test result –as cauriequ().

Returns – in show step mode: $\begin{bmatrix} \varphi & \frac{d\varphi}{d\,\text{var1}} & \frac{d\psi}{d\,\text{var2}} & \frac{d\varphi}{d\,\text{var1}} - \frac{d\psi}{d\,\text{var2}} \\ \psi & \frac{d\varphi}{d\,\text{var2}} & \frac{d\psi}{d\,\text{var1}} & \frac{d\varphi}{d\,\text{var2}} + \frac{d\psi}{d\,\text{var1}} \end{bmatrix}$

Information file for using CAT
-version 2.0.0

cross(Z1,Z2):
Returns: the complex cross product of Z1 and Z2.
Returns – in show step mode: $\left\{\overline{\varphi 1}, \overline{\varphi 1} * Z2, \mathrm{Im}(\overline{\varphi 1} * Z2)\right\}$

curl(Z):
Returns: the complex curl of Z.
Returns – in show step mode: $\begin{bmatrix} \varphi & \frac{d\psi}{d\,\mathrm{var}2} & - \\ \psi & \frac{d\psi}{d\,\mathrm{var}1} & \frac{d\psi}{d\,\mathrm{var}1} - \frac{d\psi}{d\,\mathrm{var}2} \end{bmatrix}$

div(Z):
Returns: the complex diverges of Z.
Returns – in show step mode: $\begin{bmatrix} \varphi & \frac{d\psi}{d\,\mathrm{var}1} & - \\ \psi & \frac{d\psi}{d\,\mathrm{var}2} & \frac{d\psi}{d\,\mathrm{var}2} + \frac{d\psi}{d\,\mathrm{var}1} \end{bmatrix}$

dot(Z1,Z2):
Returns: the complex dot product of Z1 and Z2
Returns – in show step mode: $\left\{\overline{\varphi 1}, \overline{\varphi 1} * Z2, \mathrm{Re}(\overline{\varphi 1} * Z2)\right\}$

grad(Z):
Returns: the complex gradient of Z.
Returns – in show step mode: $\begin{bmatrix} \varphi & \frac{d\varphi}{d\,\mathrm{var}1} & \frac{d\psi}{d\,\mathrm{var}2} & - \\ \psi & \frac{d\varphi}{d\,\mathrm{var}2} & \frac{d\psi}{d\,\mathrm{var}1} & \frac{d\varphi}{d\,\mathrm{var}1} - \frac{d\psi}{d\,\mathrm{var}2} + i*(\frac{d\varphi}{d\,\mathrm{var}2} + \frac{d\psi}{d\,\mathrm{var}1}) \end{bmatrix}$

poten(Z):
Returns: the complex potential of Z.
Returns – in show step mode: $\begin{bmatrix} \frac{dZ}{d\,\mathrm{var}1} & \frac{d^2Z}{d(\mathrm{var}1)^2} & - \\ \frac{dZ}{d\,\mathrm{var}2} & \frac{d^2Z}{d(\mathrm{var}2)^2} & \frac{d^2Z}{d(\mathrm{var}1)^2} + \frac{d^2Z}{d(\mathrm{var}2)^2} \end{bmatrix}$

Information file for using CAT
-version 2.0.0

harmconj(φ,point) - Calculates the conjugation of harmonic complex function:
Returns: ψ
Returns – in show step mode:

$$\begin{bmatrix} \frac{d\varphi(\text{point}(\,LHS\,(\text{var}\,1)),n)}{d\ \text{var}\,1} & \int_{\text{point}(\,LHS\,(\text{var}\,2))}^{\text{var}\,2} \frac{d\varphi(0,n)}{d\ \text{var}\,1}dn & - \\ \frac{d\psi(\xi,\text{var}\,2)}{d\ \text{var}\,2} & \int_{\text{point}(\,LHS\,(\text{var}\,1))}^{\text{var}\,1} \frac{d\psi(\xi,\text{var}\,2)}{d\ \text{var}\,2}d\xi & \int_{\text{point}(\,LHS\,(\text{var}\,2))}^{\text{var}\,2} \frac{d\varphi(0,n)}{d\ \text{var}\,1}dn - \int_{\text{point}(\,LHS\,(\text{var}\,1))}^{\text{var}\,1} \frac{d\psi(\xi,\text{var}\,2)}{d\ \text{var}\,2}d\xi + \text{point}(\,RHS\,) \end{bmatrix}$$

Note: The point must be given as an equation:
- LHS is a function of two variables. The name is unimportant but the first argument must be var1 and the second var2.
- RHS is the function value in the point.

laplaceq(φ) –Laplaces equations:

Returns: $\left\{ \frac{d^2\varphi}{d(\text{var1})^2} + \frac{d^2\varphi}{d(\text{var}\,2)^2} \quad \frac{d^2\psi}{d(\text{var1})^2} + \frac{d^2\psi}{d(\text{var}\,2)^2} \right\}$

Returns – in show step mode: $\begin{bmatrix} \varphi & \frac{d^2\varphi}{d(\text{var1})^2} & \frac{d^2\varphi}{d(\text{var}\,2)^2} & \frac{d^2\varphi}{d(\text{var1})^2} + \frac{d^2\varphi}{d(\text{var}\,2)^2} \\ \psi & \frac{d^2\psi}{d(\text{var1})^2} & \frac{d^2\psi}{d(\text{var}\,2)^2} & \frac{d^2\psi}{d(\text{var1})^2} + \frac{d^2\psi}{d(\text{var}\,2)^2} \end{bmatrix}$

cexpand(Z) or cexpand({Z,cvar}) –Complex expansion:
Returns: the expanded expression.
Note 1: In the returned expression complex ***i*** will be replaced by i.
Note 2: No show step mode.

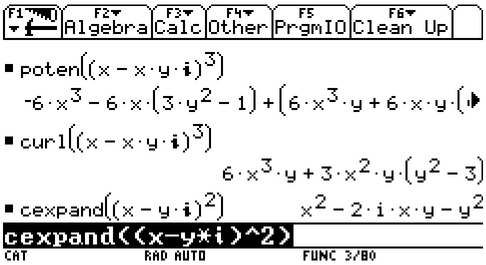
climit(Z,cvar,limit) or climit(Z,cvar,{limit,hand}) –Complex limit:
Returns: the complex limit.
Note: No show step mode.

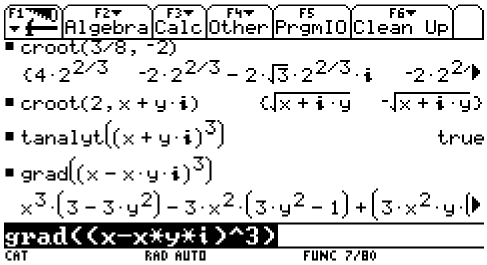
poles(Z,cvar) –Poles:
Returns: the poles in a list.
Note: No show step mode.

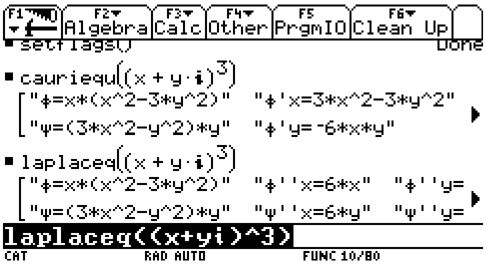
croot(n,Z):
Returns: the complex n^{th} root(s) of Z in a list.
Note: No show step mode.

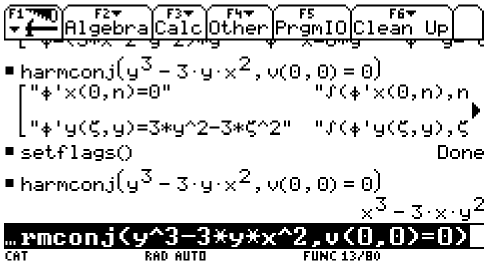
Information file for using CAT
-version 2.0.0

Examples of use:





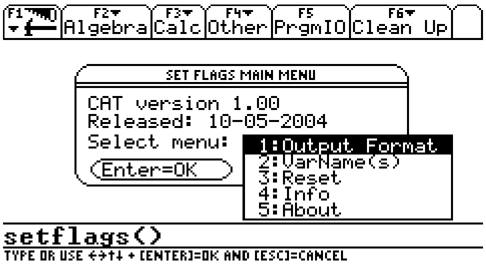




How to change the flag-settings:

To ensure the end-user a high level of flexibility CAT offers a utility that can change how the functions behave.

To enter the utility execute the program setflags():



Push ENTER or ESC to get the main menu:

By pushing the arrows ←↑↓ → or a number from 1 to 5 you can now interact in the program:

3: Here you can reset the flags for CAT.

4: Gives the start-up info again.

5: Gives the more general information on CAT.

The other selections give menus where specific changes of flag-setting are possible. In these menus the currently enabled settings are marked by "√" (the OK character) and disabled by a: "■":

1: In this menu you can change the output formats of the function in CAT:

Prefer ®Show step(s)?:
1 -Yes: If possible a function will return the steps used for calculating the result.

2 -No: A function will only return the result.

Prefer ®i?:
1 -Yes: All CAT functions will always return expressions where ***i*** is replaced by the letter i.

2 -No: Unless it is specified in a note then CAT always will return expressions where $\sqrt{-1}$ = ***i***.

Use a Func name:
1 -Yes: You can specify an often used complex function in CAT. The complex function will automatically generate an-easy-to-use variable that isn't underscored. So z will correspond to z_ as long as you execute CAT functions from the cat\ directory. If you define z as a func name and write conj(z) you get conj(z_) otherwise you conj(z) returns z.

2 -No: No function will be specified.

Set name of Func *(only if: Use a Func name is set to Yes)***:** Give a function name.

Define Func *(only if: Use a Func name is set to Yes)***:** Define the function.

2: In this menu you can change the name of var1 and var2 that is used in CAT

Information file for using CAT
-version 2.0.0

What's new?
I have made improvements to most functions. Among the improvements is the automatic underscoring of complex variables, and the "func name" will also be underscored automatically.

New updates?
Maybe I will add some tools for residues, complex integration and some graphical tools.

Thanks to:
Bhuvanesh Bhatt for enlightening me on the how to underscore variables to make sure that they are viewed as complex.

Copyright 2004 Mads Soendergaard:

Disclaims: I am not responsible of any damage/problems that CAT might cause on your calculator, neither of any damage/problems caused by faults in the documentation of CAT.

Other issues: If you want to ask some questions or if you find a bug then write to me:
Mads Soendergaard, mailto: sondermad@hotmail.com

-The release date of this document is 07-09-2004.