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A STUDY ON SOLVING DOUBLE AND TRIPLE INTEGRAL USING SAGEMATH SOFTWARE

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Abstract— Double and triple integral is essentialfor different application in technical and other sciences. The normal procedure to solve mathematical problems is by using particular formula. Another approach to solve the mathematical problem is by using mathematical software's. SAGEMATH is one of the software to solve mathematical problem. In this research, we introduce a new algorithm and a flow chart to find double and triple integral in SAGEMATH software. The main objectives of this method are 1.It reduces the time taken to solve the sum. 2. It reduces more steps and 3. In future, it can be used in educational field to solve double and triple integrals. 4. This method will be more helpful for researchers.

Keywords—Integration, integral, SAGEMATH, variables, limits, function.

I. INTRODUCTION:

SAGEMATH ("System for Algebra and Geometry Experimentation") is a Computer Algebra System (CAS) with concepts covering many topics of mathematics, like Algebra, Combinatorics, Graph Theory, Numerical Analysis, Number Theory, Calculus and Statistics.
SAGEMATH is an open free source mathematics which deals with both numerical and textual problems. SAGEMATH is a powerful and very popular python programming language and the mathematics-oriented programming language.

As per the author's knowledge, no package is available in SAGEMATH to solve double and triple integral at present. In this paper, we have proposed an algorithm and the flow chart in the computer algebra system SAGEMATH software for finding the values of double and triple integral.

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II. DOUBLE INTEGRAL USING SAGEMATH:

We integrate a double integral over a 2-D region using SAGEMATH software. The general representation of double integrals is,

$$\int\int f(y,z)ds$$

The double integral can be represented as,

$$\int\int f(y,z)\,dS = \int_a^b \int_d^c f(y,z)dydz$$

A. ALGORITHM:

Step 1: First we have to assign the variables by the syntax

```
var1,var2,var3....=var('var1,var2,var3.....')
```

Step 2: Assign the given integral function to another variable which is not assigned before.

Step 3: Apply the integral for second part by the syntax

```
Integrate(function, integrand, lower
limit, upper limit)
```

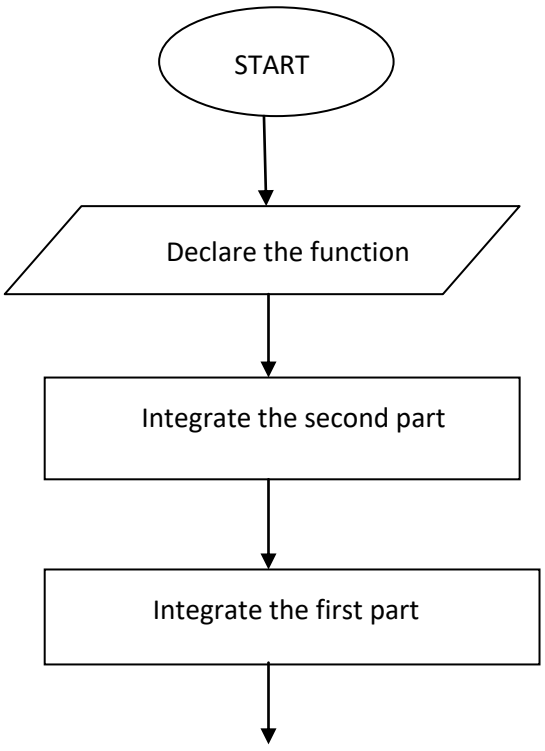
Step 4: Apply the integral for first part by the syntax

```
Integrate(step 3 var, integrand, lower
limit, upper limit)
```

Step 5: To get an output, we use the show() syntax

```
Show(step 4 var)
```

B. FLOW CHART:



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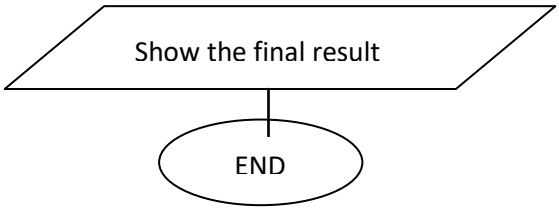
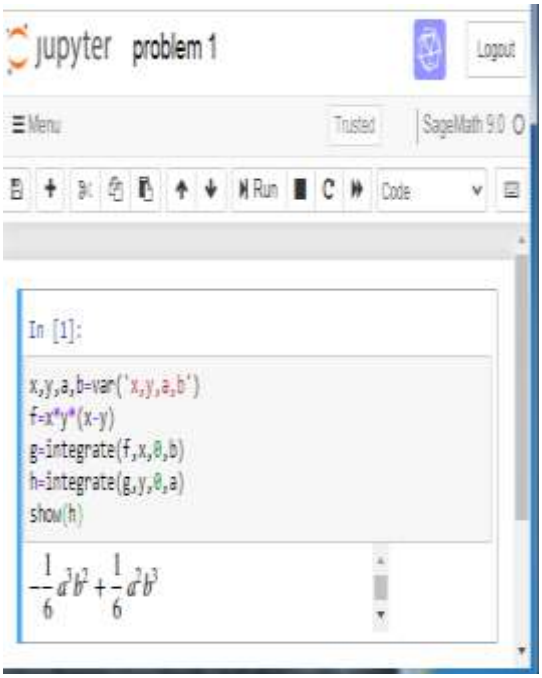


TYPE 1: Double integration in Cartesian Co-ordinates.

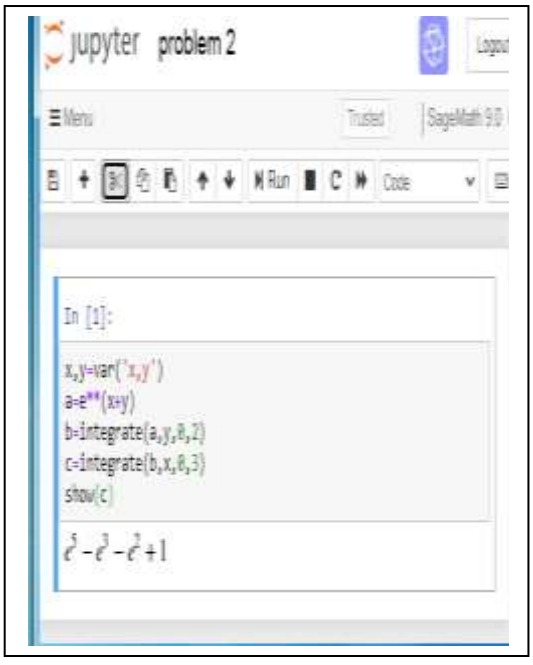
Example 1. Evaluate $\int_0^a \int_0^b xy(x-y)\,dx\,dy$

Solution:



Example 2. Evaluate $\int_0^3 \int_0^2 e^{x+y}dydx$

Solution:



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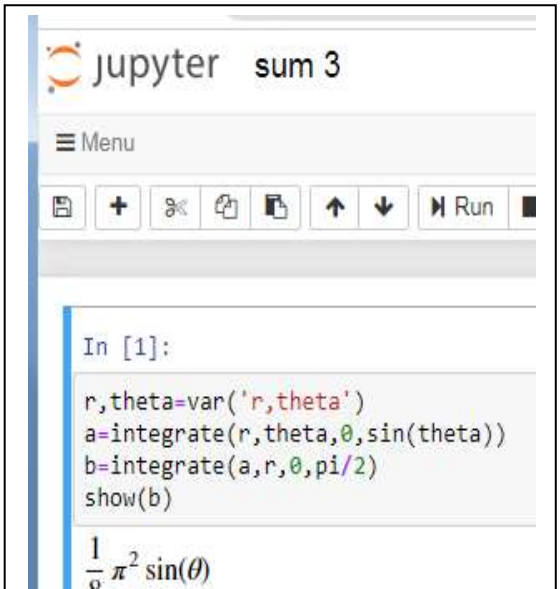
Example 3. Evaluate $\int_0^4 \int_{(x-2)^2}^{6} (42y^2 - 12x)dydx$

Solution:

TYPE 2:

Example 4. Evaluate $\int_0^{\pi/2} \int_0^{\sin\theta} r^2 dr d\theta$

Solution:



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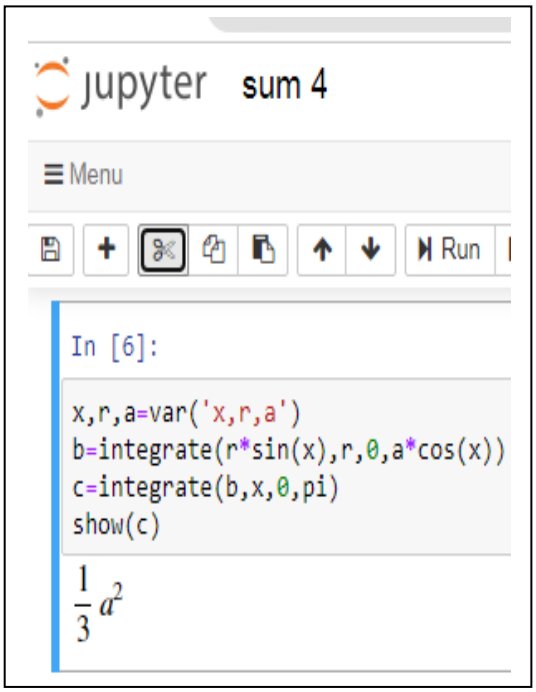
Example 5. Evaluate $\int_0^{\pi}\int_0^{acos\theta} rsin\theta drd\theta$

Solution:



III. TRIPLE INTEGRAL USING SAGEMATH:

In the previous section, double integral was used to integrate over a 2-Dregion using SAGEMATH software. Likewise, here we are using a triple integral to integrate over 3-D region using SAGEMATH software. The general representation of triple integrals is,

$$\int\int\int f(j,y,i)dv$$

The triple integral can be represented as,

$$\iiint f(j,y,i)dV = \int_s^r \int_d^c \int_b^a f(j,y,i)djdydi$$

We integrated with respect to j first, then y, and then finally i. It is not a compulsory order. We can change the order with respect to the given problem.

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```

Step 2: Assign the given integral function to another variable which is not assigned before.

Step 3: Apply the integral for third part by the syntax

```
Integrate(function, integrand, lower limit,
upper limit)
```

Step 4: Apply the integral for second part by the syntax

```
Integrate(step 3 var, integrand, lower limit,
upper limit)
```

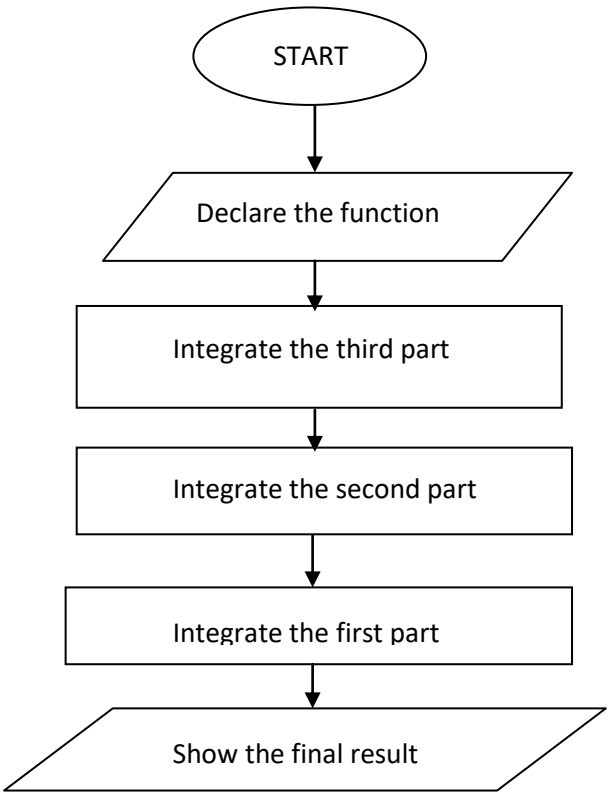
Step 5: Apply the integral for first part by the syntax

```
Integrate(step 3 var, integrand, lower limit,
upper limit)
```

Step 6: To get an output, we use the show() syntax

```
Show(step 5 var)
```

B. FLOW CHART:



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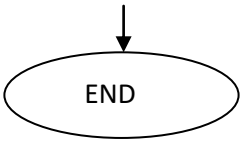
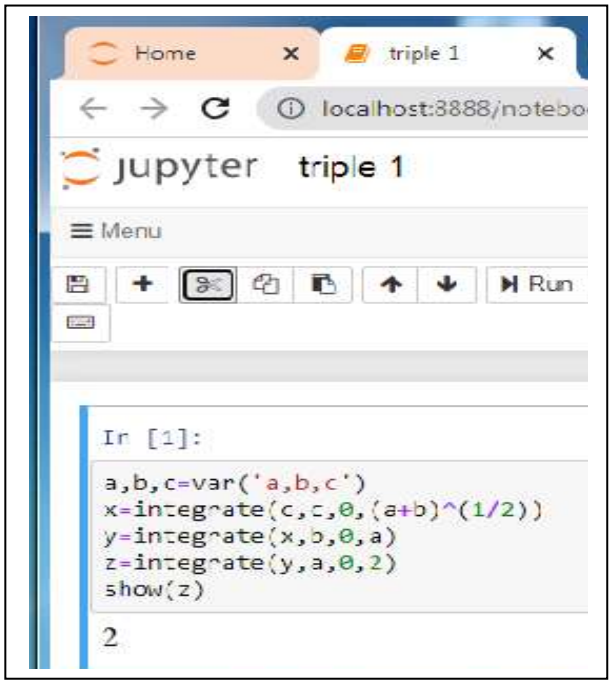


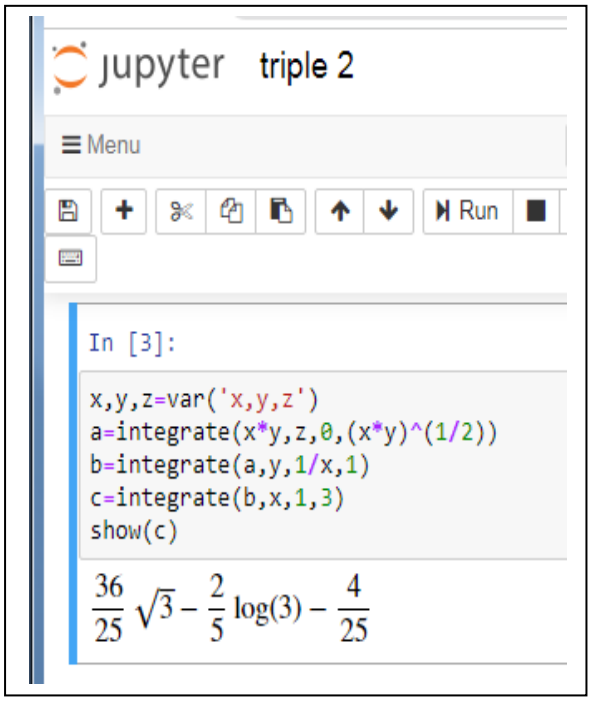
Example 6: Evaluate $\int_0^2 \int_0^a \int_0^{\sqrt{a+b}} cdzdydx$

Solution:



Example 7: Evaluate $\int_1^3 \int_1^{1/x} \int_0^{\sqrt{xy}} xydzdydx$

Solution:



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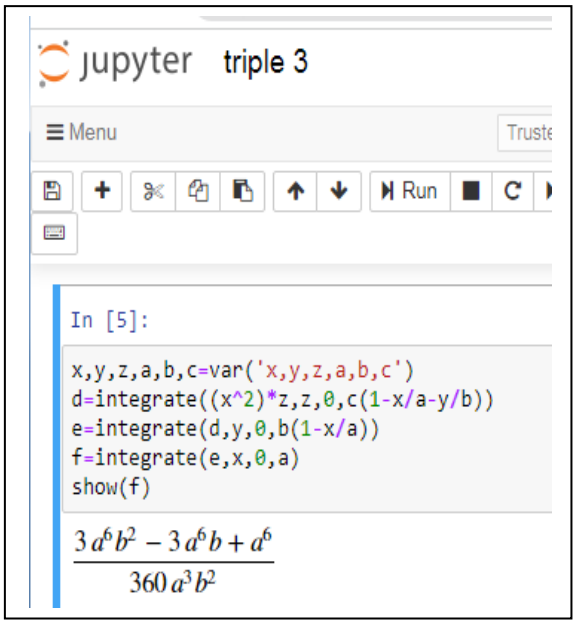
Example 8: Evaluate $\int_0^a \int_0^{b\left(1-\frac{x}{a}\right)} \int_0^{c\left(1-\frac{x}{a}-\frac{y}{b}\right)} x^2 z dz dy dx$

Solution:



IV. CONCLUSION:

In this paper, we have analyzed double and triple integral using SAGEMATH software. Using this software, we have solved double and triple integral in easy way which gives more approximate values for the solution. Using this algorithm, we solve any type of double and triple integrals in a easy way without knowing any formula.

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