Khuli Kitab: Round 3 Presentation

Team 16

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Problem Statement

- Write down the following functions in script and call these functions in command window:
  - $x = \frac{1}{1+e^{-(t-15)/6}}$
  - $y = (\sqrt{a} + \sqrt[21]{b})^{\pi}$ recall that $\sqrt[g]{h} = h^{\frac{1}{g}}$ and use **sqrt**. You can also use **nthroot**.
  - $z = \frac{log(Re[(c+d)(c-d)]sin(a\pi/3)}{c\bar{c}}$ where $Re(z)$ represents the real part of the complex number in brackets, $\bar{c}$ is the complex conjugate of c.
  - Create a single script file with the above function.
  - Find the value of $f(x, y, z)$ by calling it in command window for some values of t, a, b, c, d.

Script File

```
t = input("t = ")
a = input("a = ")
b = input("b = ")
c = input("c = ")
d = input("d = ")
[x,y,z] = f(t,a,b,c,d)

function [x,y,z] = f(t,a,b,c,d)
    x = fx(t);
    y = fy(a,b);
    z = fz(a,c,d);
end

function res = fx(t)
    res = 1./(1+exp(-(t-15)./6));
end

function res = fy(a,b)
    res = (sqrt(a)+nthroot(b,21)).^pi;
end

function res = fz(a,c,d)
    res = log(real((c+d).*(c-d)).*sin(a.*pi/3))./(c.*conj(c));
end
```

Sample Output

```
>> test
t =
randi(10,1,5)

t =

     9     7     4    10     1

a =
randi(10,1,5)

a =

     5     4     8     8     2

b =
randi(10,1,5)

b =

     5     5     7     8     8

c =
rand(1,5,"like",1i)
```

Sample Output (Contd.)

```
c =

   0.2760 + 0.6797i   0.6551 + 0.1626i   0.1190 + 0.4984i   0.9597 + 0.3404i   0.5853 + 0.2238i

d =
rand(1,5,"like",1i)

d =

   0.7513 + 0.2551i   0.5060 + 0.6991i   0.8909 + 0.9593i   0.5472 + 0.1386i   0.1493 + 0.2575i


x =

    0.2689    0.2086    0.1378    0.3029    0.0884


y =

   43.1961   34.2510   73.4146   73.8266   18.2020


z =

  -0.4940 + 0.0000i  -1.3110 + 6.8956i  -9.0371 +11.9667i  -0.7601 + 0.0000i  -3.1406 + 0.0000i
```

Notes

- The class complex does not directly support rand. [1]
- $\log(-|x|) = \log(|x|) + i\pi$ [2]

[1] https://in.mathworks.com/help/matlab/ref/randn.html

[2] https://math.stackexchange.com/questions/2089690/log-of-a-negative-number

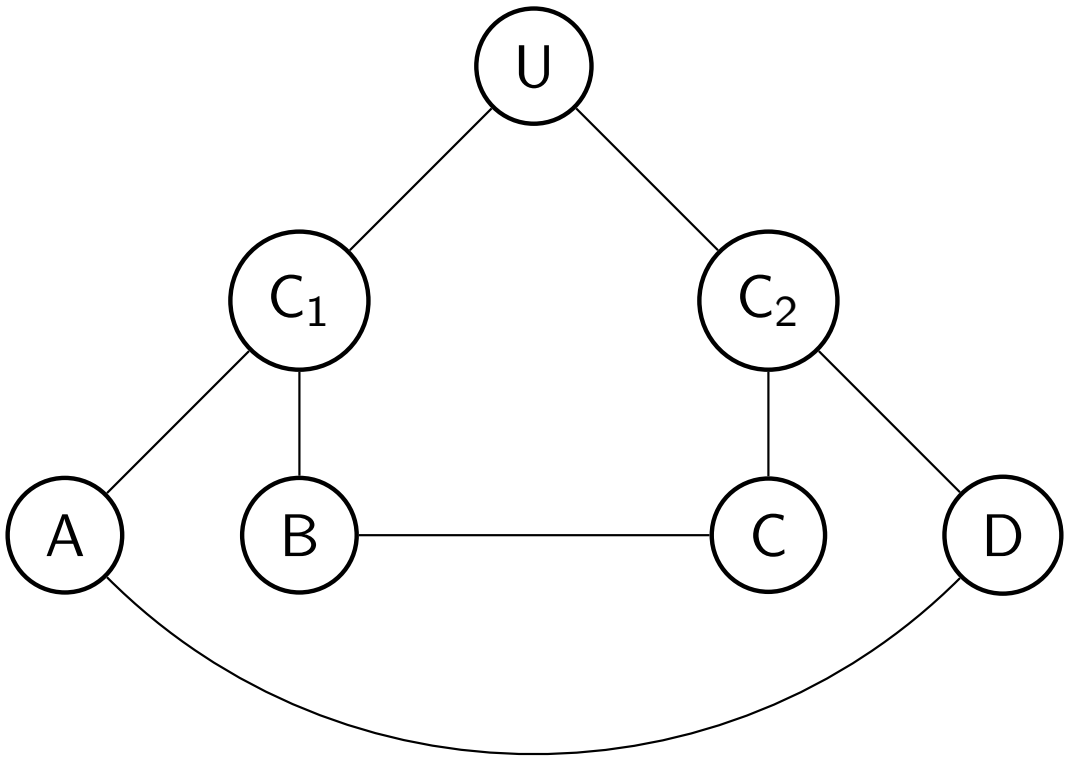
Problem Statement

In GDSC-IEM club of your college, the Professor asks the students of the 1st year and the 2nd year to form collaborative groups, each consisting of 2 members – one from the 1st year and the other from the 2nd year. Professor has also told the students that there will be an interview after 3 months to track the progress of each student. The interview panels will be formed in such a way that all the 1st year students will sit in Seminar Hall 1 and all the 2nd year students will sit in Seminar Hall 2. In the meantime one day Professor calls the Coding Lead of IEM Coding club and gives him arbitrary seating arrangements of the students in Seminar Hall 1 and Seminar hall 2, provided the students may or may not have sat in their proper Halls. Professor asks him to visualize the given seating arrangements of the students, using a graph and to figure out whether each student has sat in the proper Hall, using any graph traversal algorithm. How they have sat in the Halls is not the matter of concern here. The Coding lead then represents each student as a node and draws an edge between two nodes if the corresponding two students have formed a group between them. Now it is your task to help the Coding lead to design the algorithm to find out the answer of what Professor has asked him.

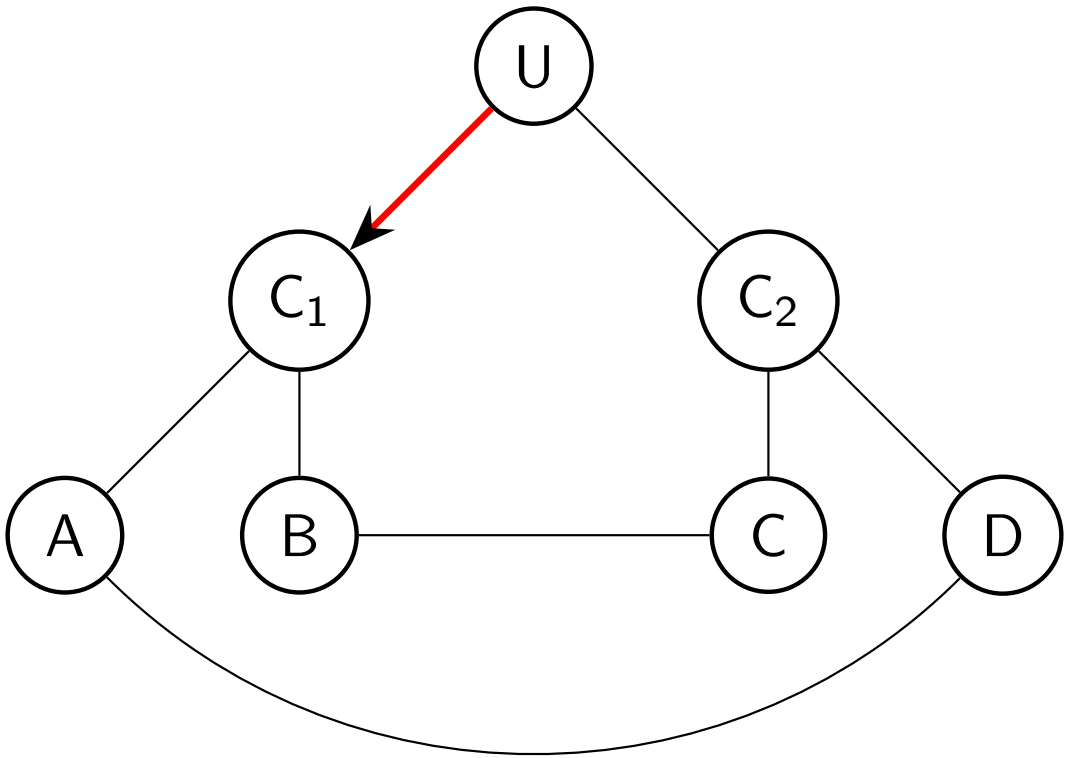
General Idea

- The two sets of students, classified based on their year and assigned hall should be disjoint.
- Ideally, each student node of "class 1" has an edge to a student node of "class 2".
- When modelled in a hierarchical structure, the two linked nodes along with their associated classes would form a cycle.

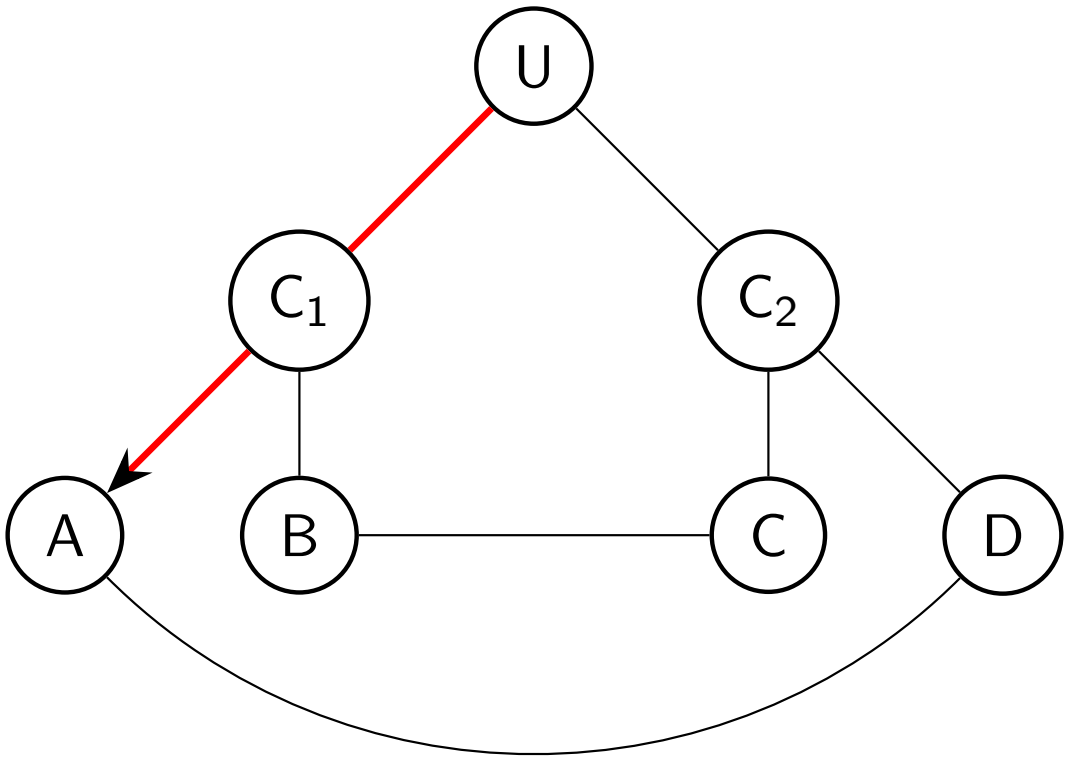
Pictorial Representation



DFS Simulation



DFS Simulation



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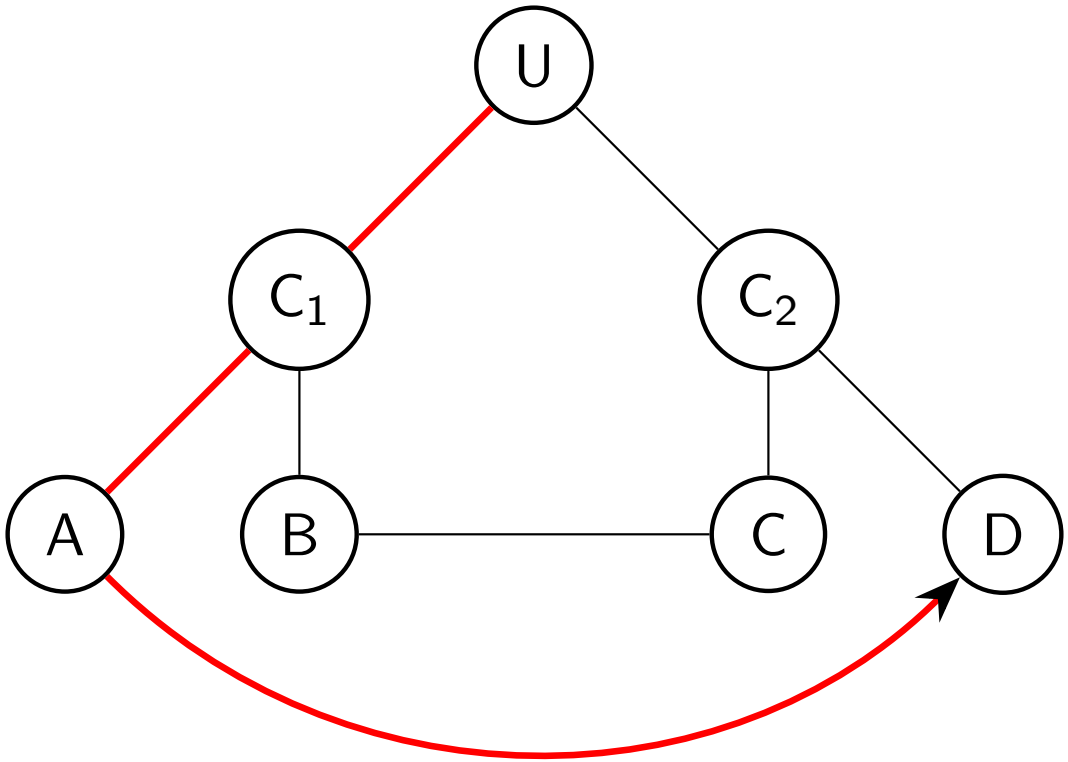

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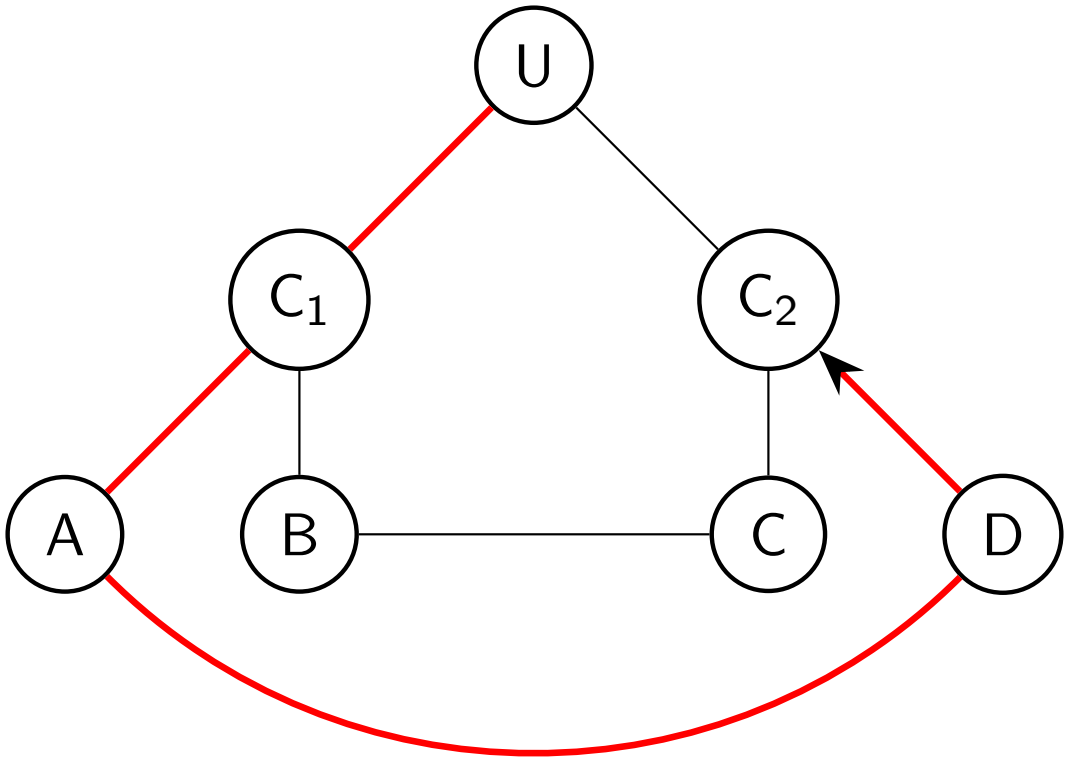

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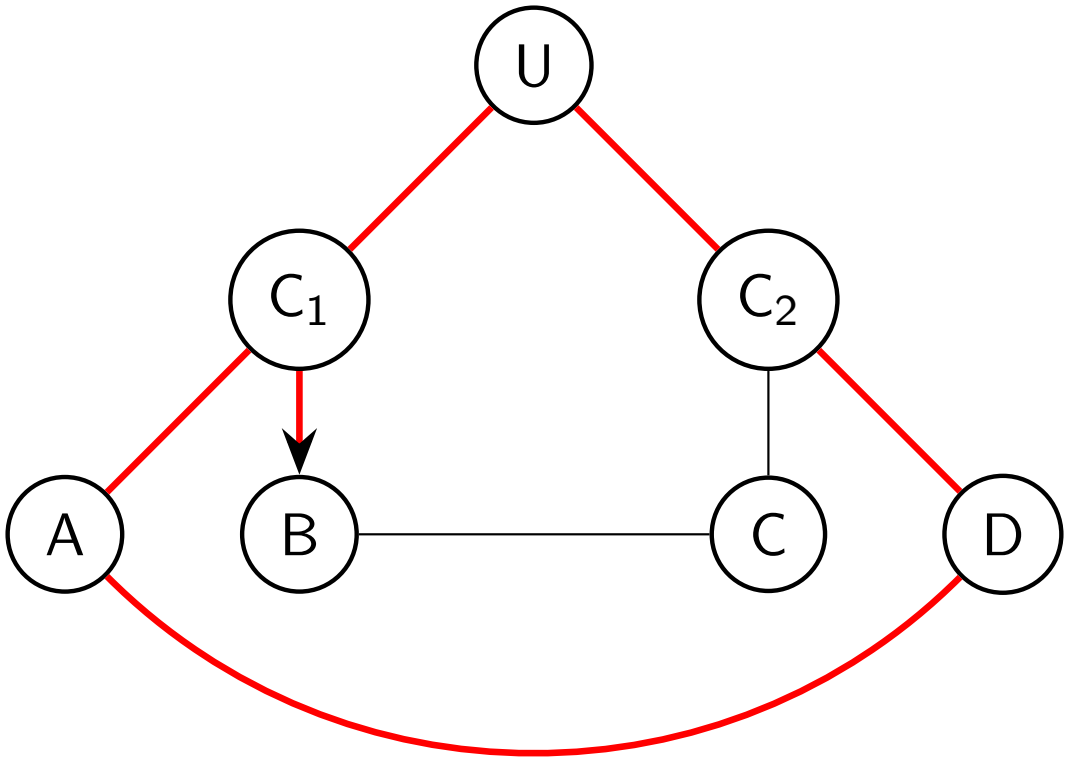

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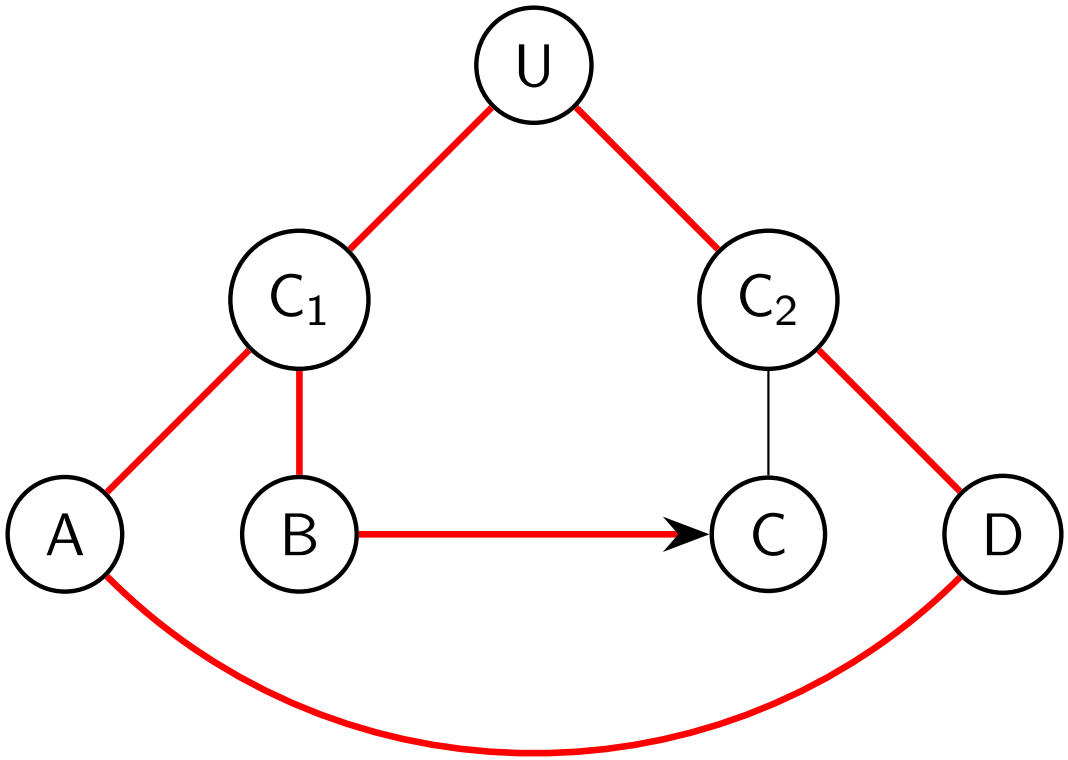

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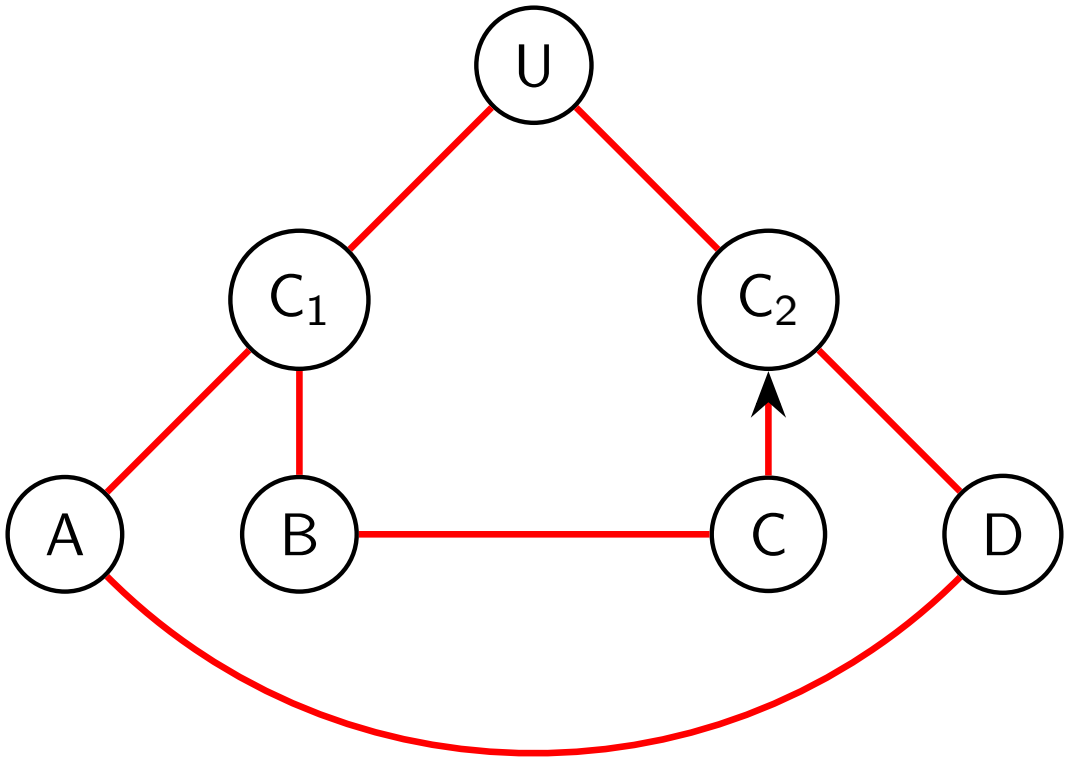
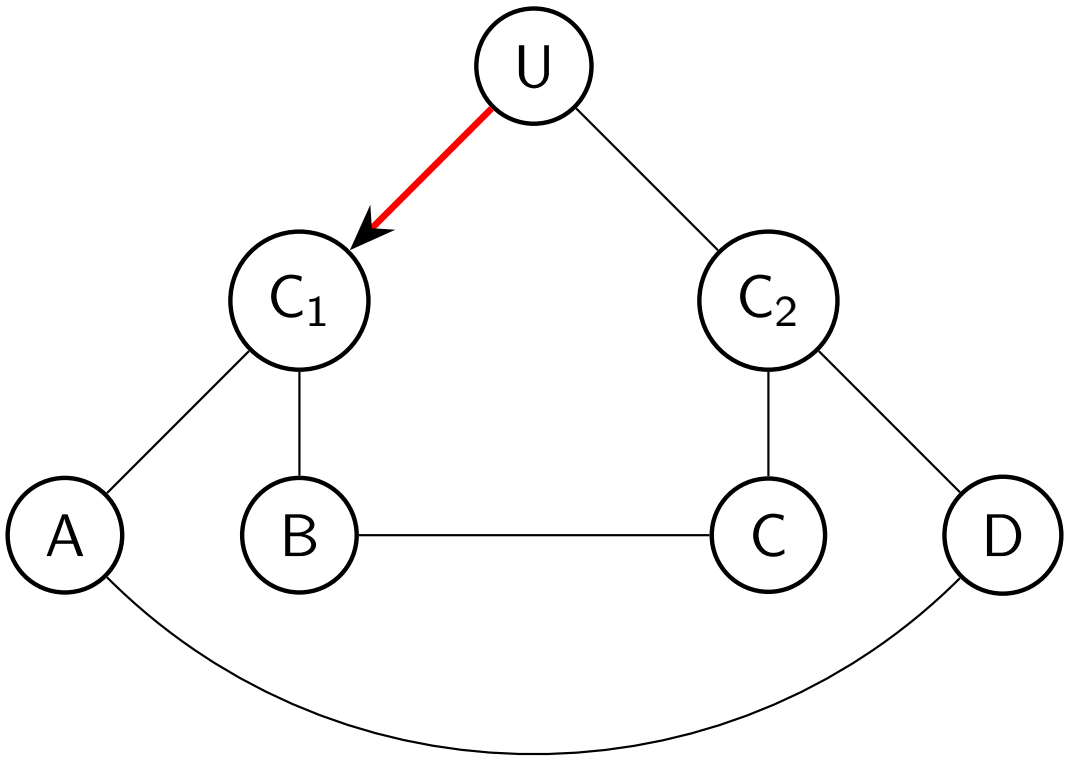


BFS Simulation



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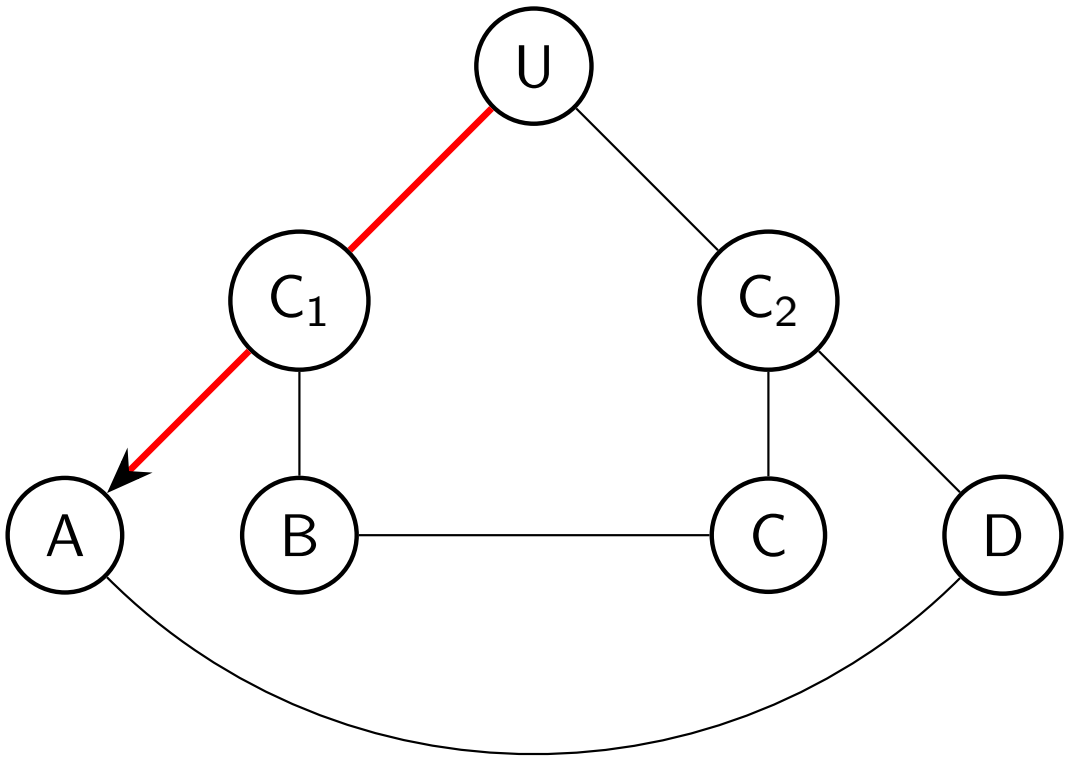

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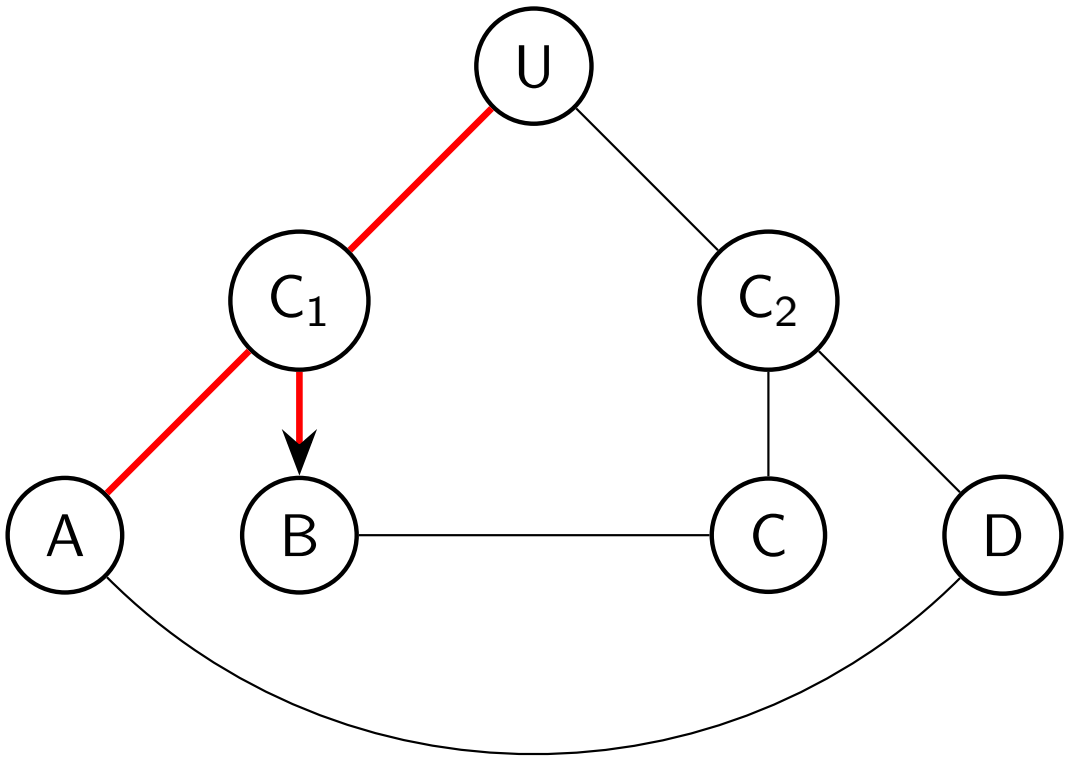

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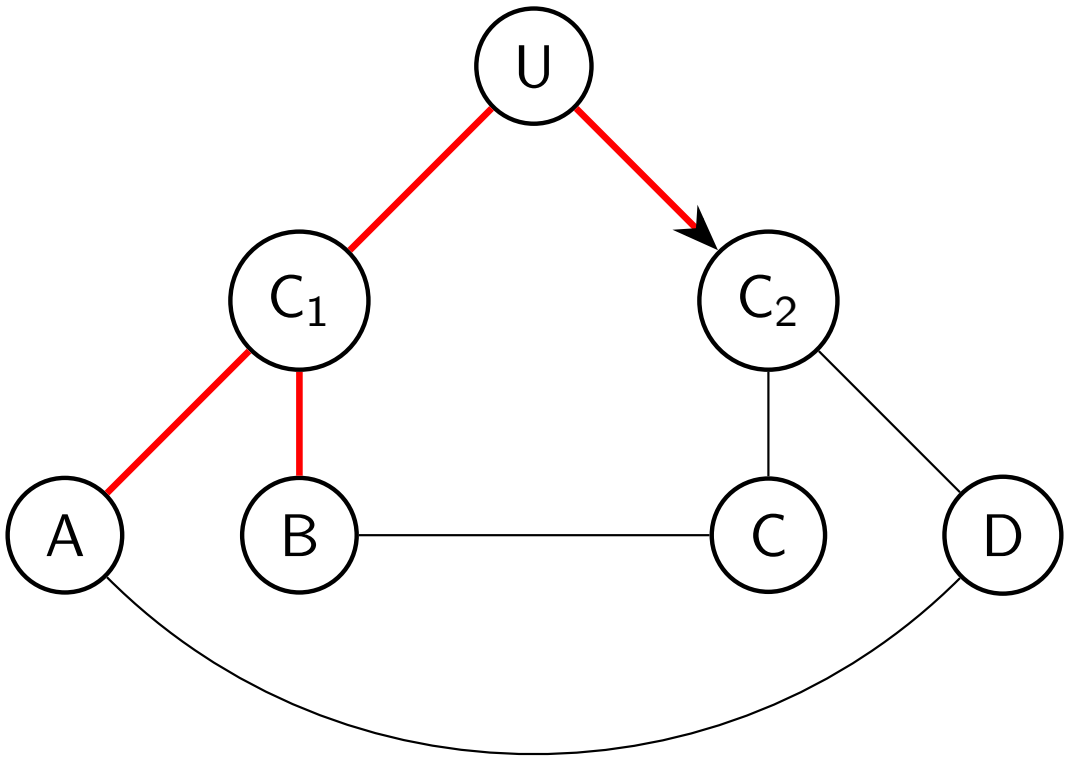

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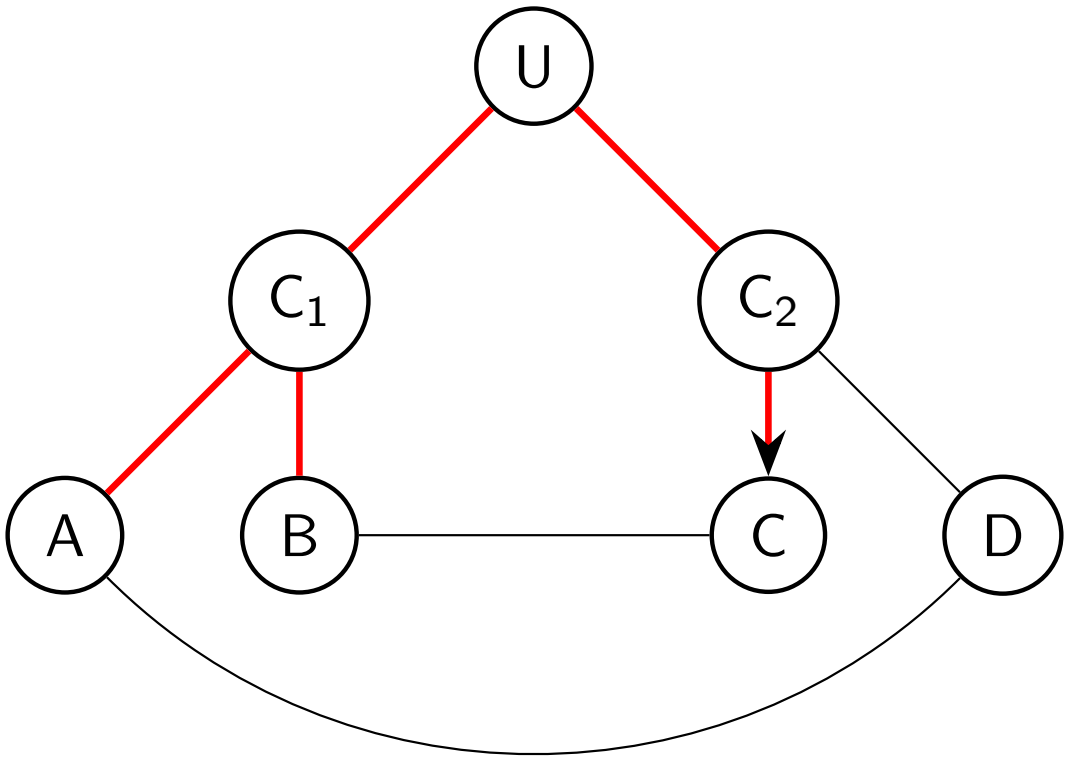

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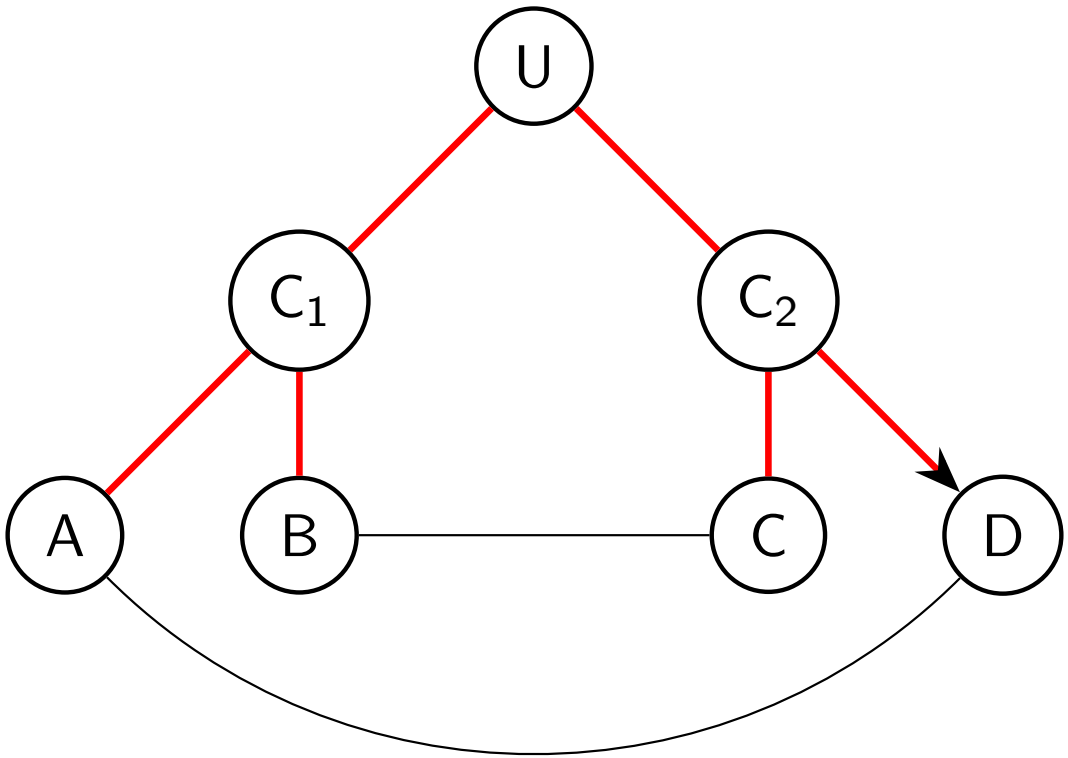

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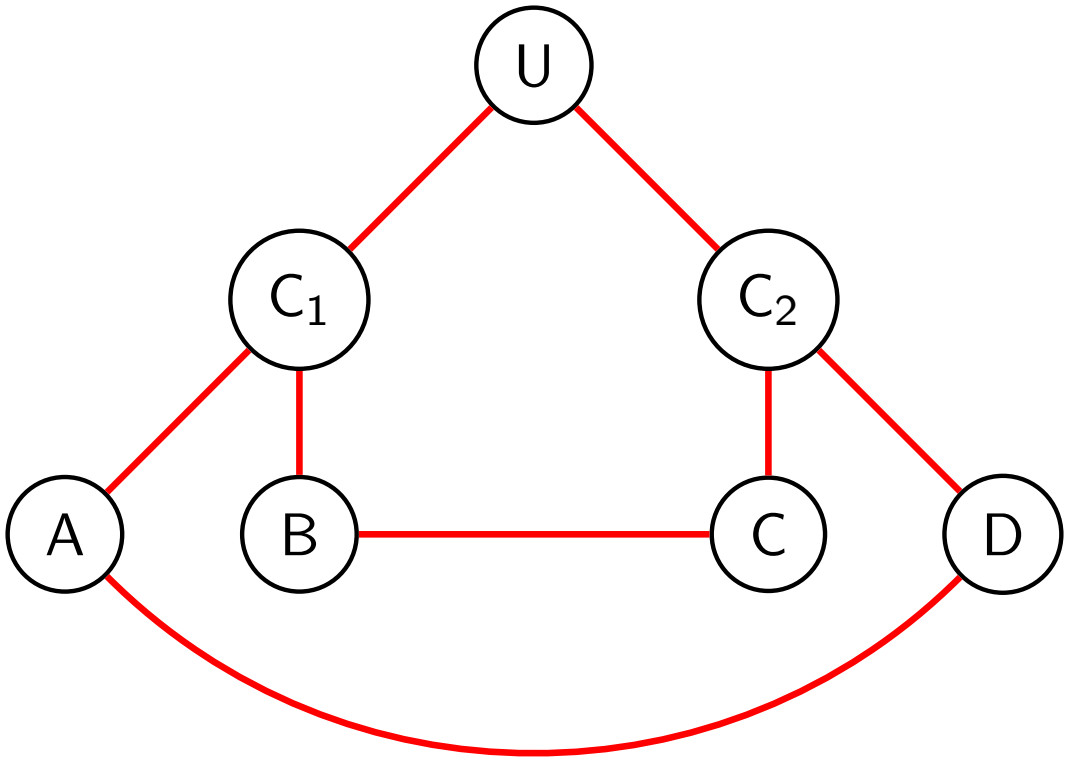


Task 1: 3 x 3 Grid Circuit

Design a 3x2 grid sub-circuit, where

(a) Each tile of same colour plays an audio note of increasing frequency. Say, 2V {1KHz, 2KHz, 3KHz, 4KHz, 5KHz, 6KHz, 7KHz} (The values of the audio note frequencies are unimportant but the mechanism that they can play is important.) The playing of the audio is regarded as switching-on of an output. The stepping of a person on the tile is regarded an input sinusoidal voltage signal (0 to 5V) which changes by a threshold value, say 3.4V when someone steps on it.

(b) Two adjacent tiles of different colours will play notes of same frequency by different amplitude. Blue tile, if plays 2V amplitude, Yellow tile will play 4V and Purple tile will play 1V. The ratio of the amplitudes of the adjacent tiles are important. All adjacent tiles will have the same input audio as sinusoidal voltage signal with fixed frequency.

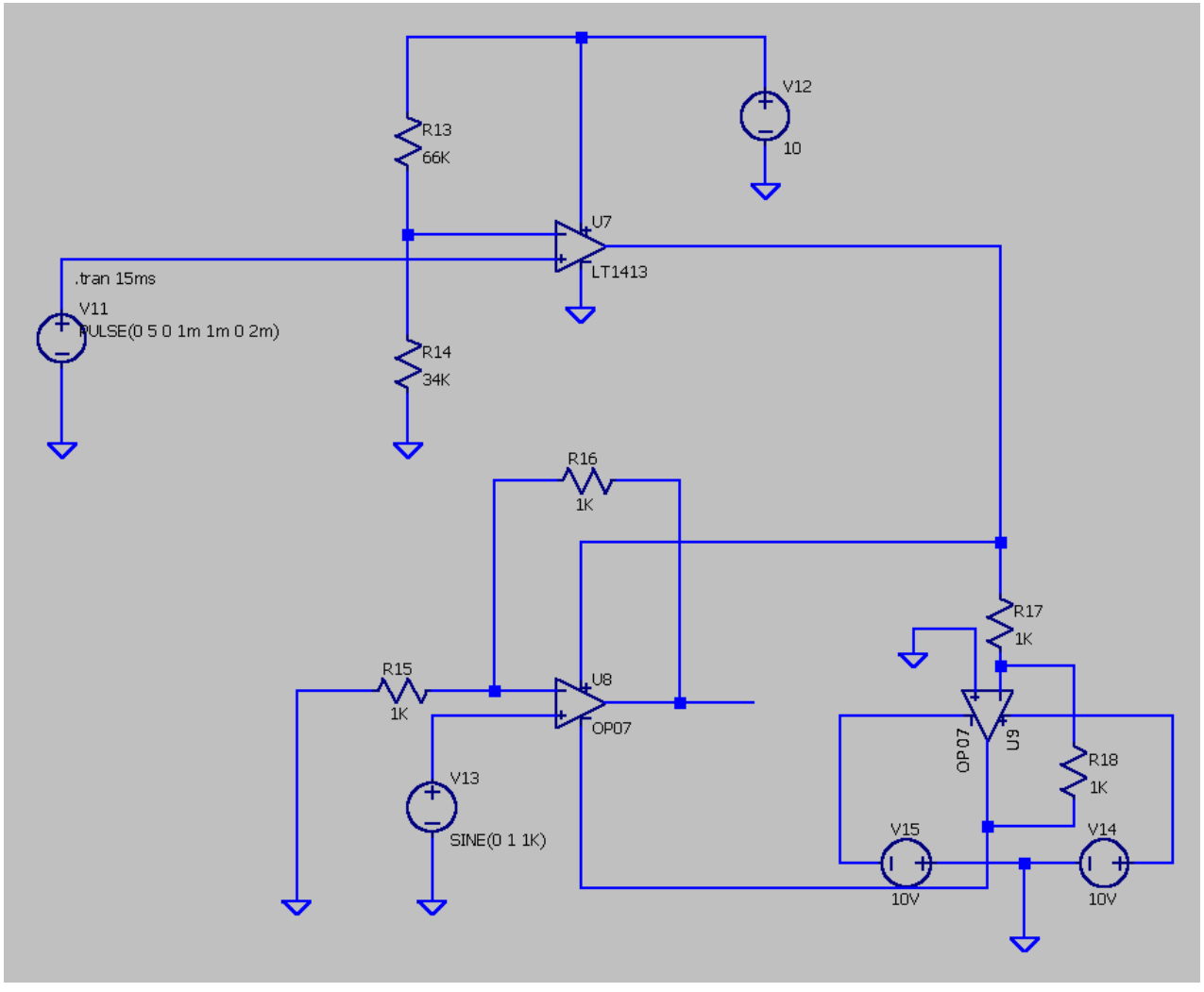
(c) Combine parts (a) and (b) to create a combine 3x3 grid circuits (Use LTSPICE or LogiSIM as necessary)

Before we begin ...

- Inverting Op-Amp: $V_{out} = -V_{in}(\frac{R_f}{R_i})$
- Non-Inverting Op-Amp: $V_{out} = V_{in}(1 + \frac{R_f}{R_i})$
- Comparator Circuit: $V_{ref} = V_{cc}(\frac{R_2}{R_1+R_2})$
- SR Latch:

S	R	Q(t)
0	0	Q(t-1)
0	1	0
1	0	1
1	1	x

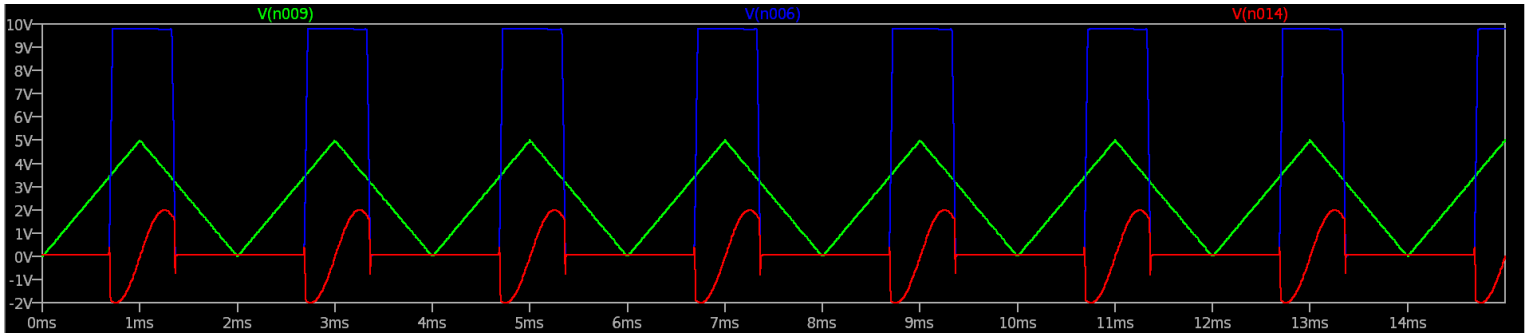
3 x 3 Grid Circuit: LTSpice Implementation



[3]

[3] All related sub-circuits can be viewed at https://drive.google.com/drive/folders/11FBcbt0VSiStgkc58DgP752aqUSDslBA

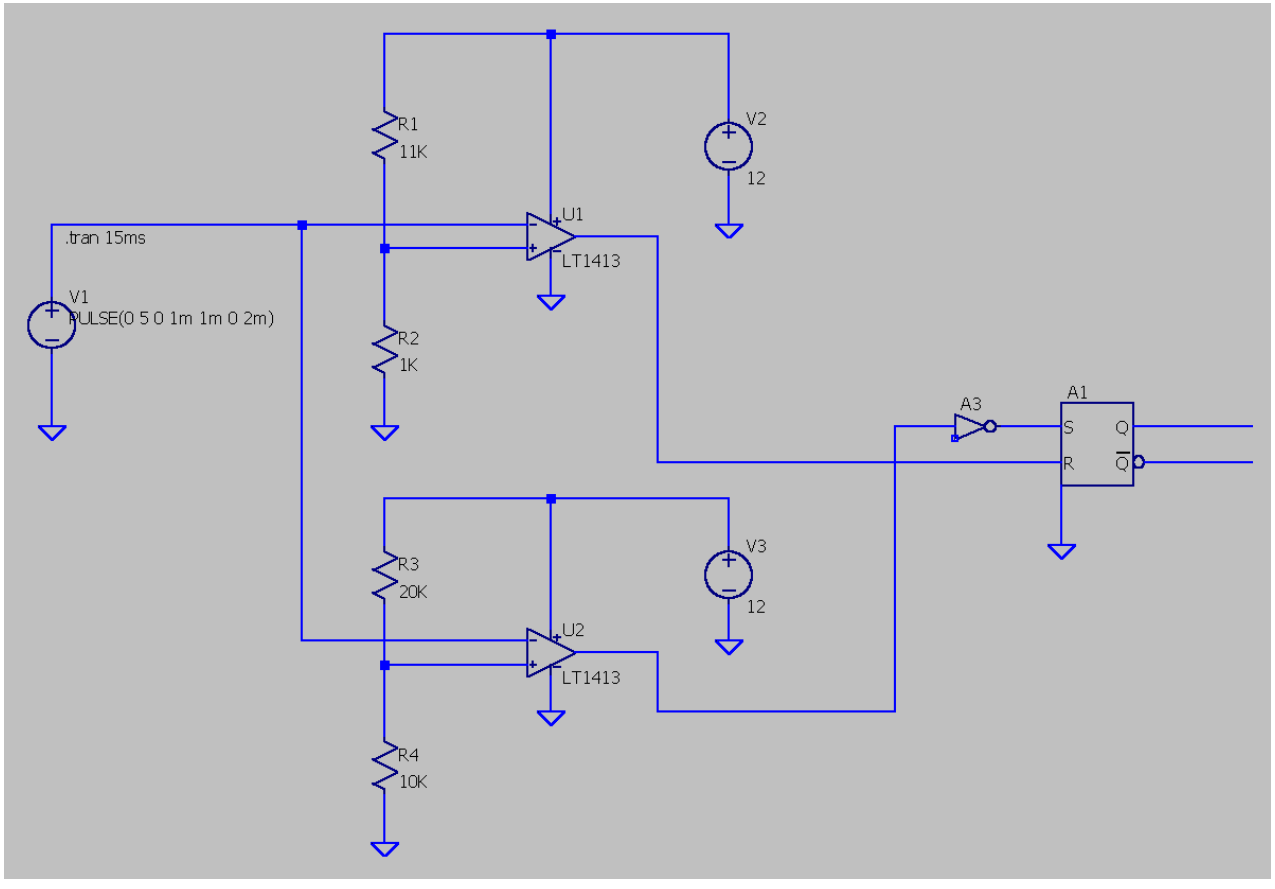
3 x 3 Grid Circuit: Sample Output



Task 2: Lighting based on Audio Level

Design a sub-circuit which if attached to the system can take audio noises as voltage signals (0 to 5V range) and switch-on the system when volume is above 4V till the volume goes below 1V. The output of this sub-circuit will control one or bunch of lights together.

Lighting based on Audio Level: LTSpice Implementation



Lighting based on Audio Level: Sample Output

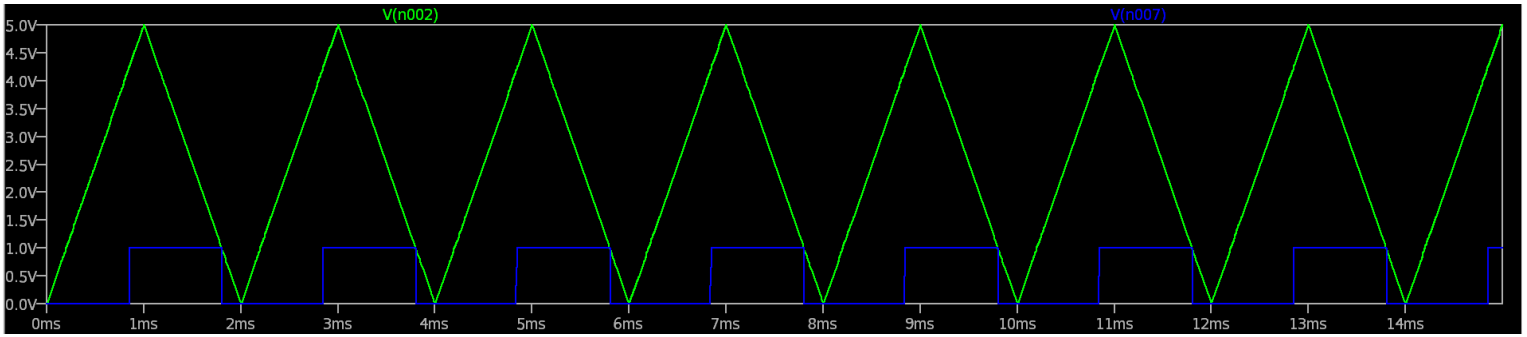


Figure: Input and Output Waveform

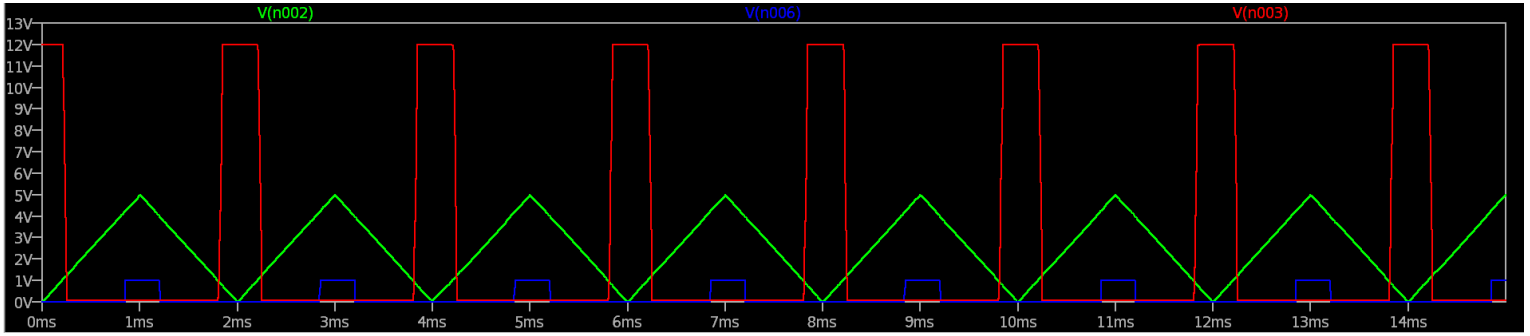
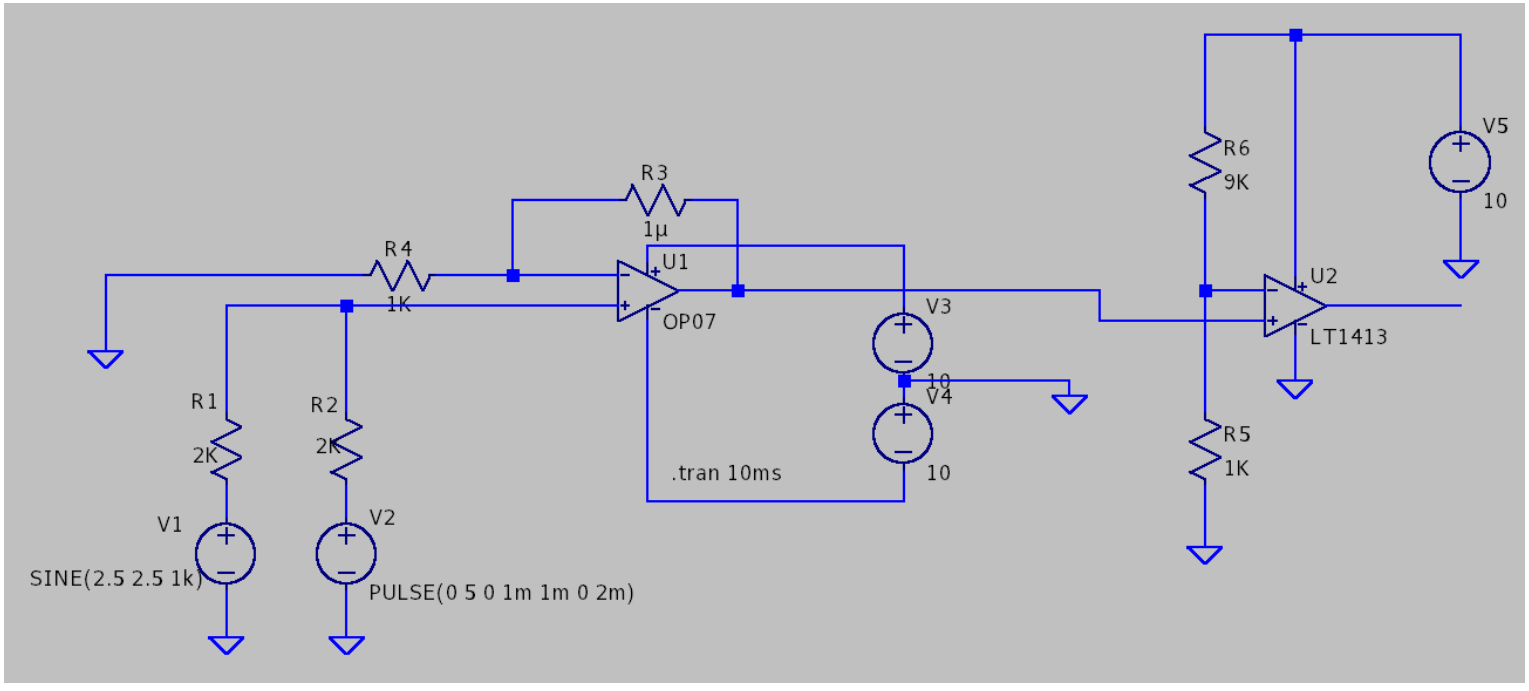


Figure: Inputs to the SR Latch

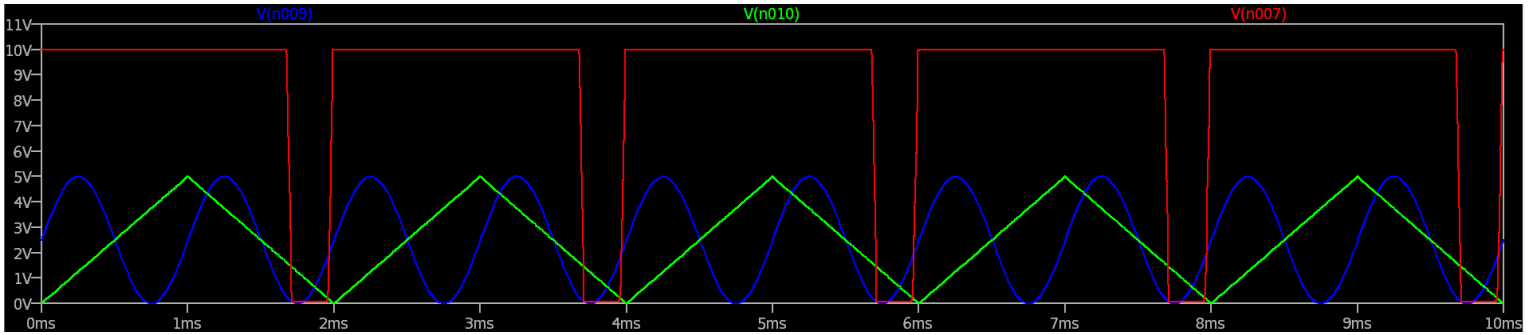
Task 4: Temperature Detection

Design a sub-circuit which if attached to the fan, will detect temperature as a voltage signal of 0-5V from the front and back of the fans. If the average value of the sensors, goes below say 1V, then the fan will switch off, else stay on.

Temperature Detection: LTSpice Implementation



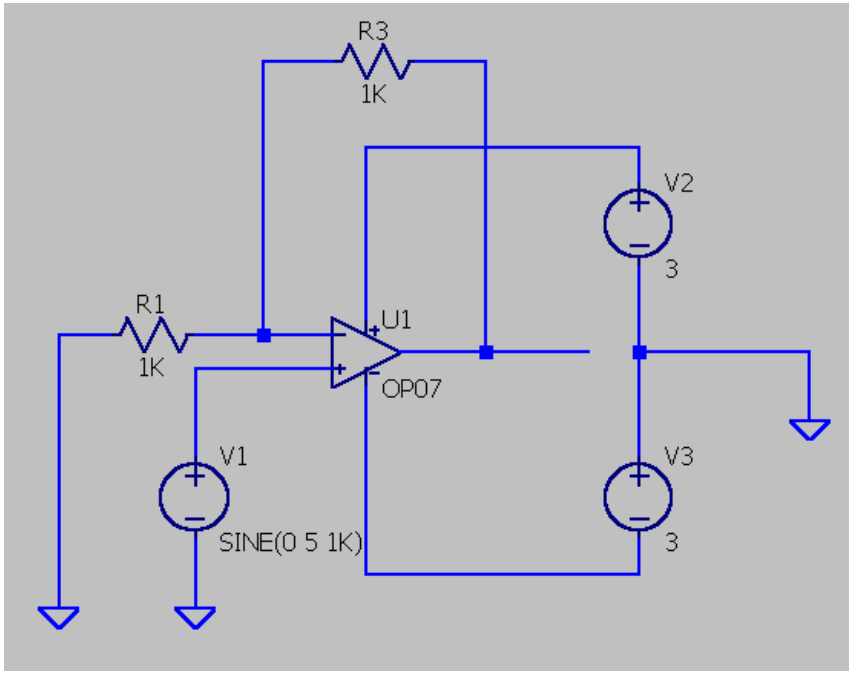
Temperature Detection: Sample Output



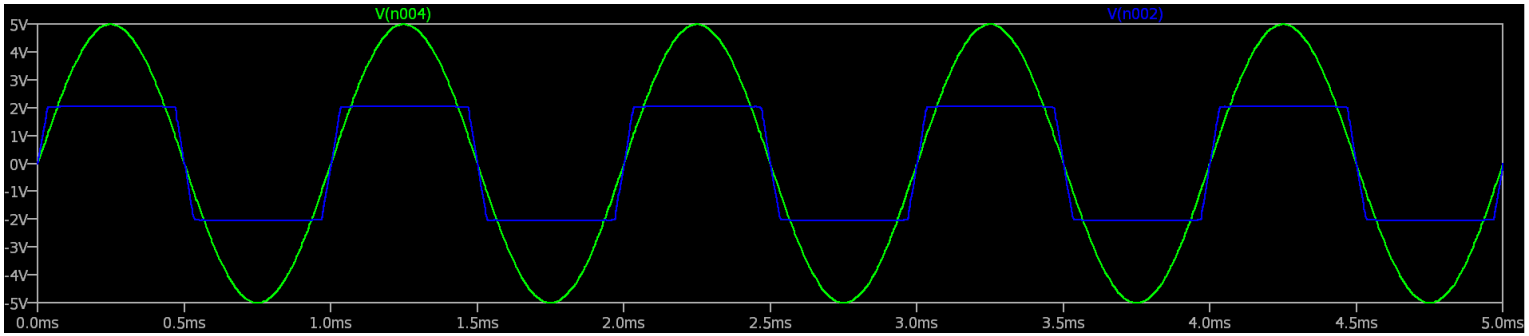
Task 5: Chopping of Peaks

Design a sub-circuit which will capture audio signals as it and chop of any peaks that are above a user-choice based level of voltage reading.

Chopping of Peaks: LTSpice Implementation



Chopping of Peaks: Sample Output



Thank You!