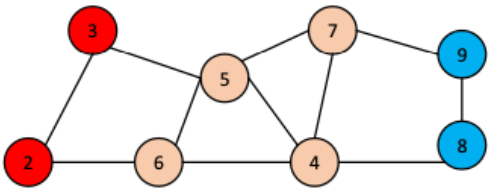
1. 利用模块度的定义 (公式 13.1) 计算下图中划分的模块度。

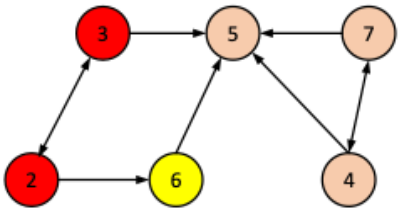



$$m = 11 \; k_2 = k_3 = k_8 = k_9 = 2 \; k_4 = k_5 = 4 \; k_6 = k_7 = 3$$

$$\begin{aligned}
Q &= \frac{1}{2m}[(0-\frac{k_2^2}{2m})+2(1-\frac{k_2k_3}{2m})+(0-\frac{k_3^2}{2m})+(0-\frac{k_4^2}{2m})+2(1-\frac{k_4k_5}{2m})+2(1-\frac{k_4k_6}{2m})+2(1-\frac{k_4k_7}{2m}) \\
&+(0-\frac{k_5^2}{2m})+2(1-\frac{k_5k_6}{2m})+2(1-\frac{k_5k_7}{2m})+(0-\frac{k_6^2}{2m})+(0-\frac{k_7^2}{2m})+(0-\frac{k_8^2}{2m})+2(1-\frac{k_8k_9}{2m})+(0-\frac{k_9^2}{2m})] \\
&= \frac{1}{22}[(0-\frac{4}{22})+2(1-\frac{4}{22})+(0-\frac{4}{22})+(0-\frac{16}{22})+2(1-\frac{16}{22})+2(1-\frac{12}{22})+2(1-\frac{12}{22})+(0-\frac{16}{22}) \\
&+2(1-\frac{12}{22})+2(1-\frac{12}{22})+(0-\frac{9}{22})+(0-\frac{9}{22})+(0-\frac{4}{22})+2(1-\frac{4}{22})+(0-\frac{4}{22})] \\
&= \frac{20}{121}
\end{aligned}$$

因此，模块度为 $\frac{20}{121}$

2. 计算下面有向带权图中划分的模块度。




$$m = 9, k_2^{in} = k_3^{in} = k_4^{in} = k_6^{in} = k_7^{in} = 1, k_5^{in} = 4$$

$$k_2^{out} = k_3^{out} = k_4^{out} = k_7^{out} = 2, k_5^{out} = 0, k_6^{out} = 1$$

$$\begin{aligned}
Q &= \frac{1}{m}[(0-\frac{k_2^{out}k_2^{in}}{m})+(1-\frac{k_2^{out}k_3^{in}}{m})+(1-\frac{k_3^{out}k_2^{in}}{m})+(0-\frac{k_3^{out}k_3^{in}}{m})+(0-\frac{k_4^{out}k_4^{in}}{m}) \\
&+(1-\frac{k_4^{out}k_5^{in}}{m})+(1-\frac{k_4^{out}k_7^{in}}{m})+(0-\frac{k_5^{out}k_5^{in}}{m})+(0-\frac{k_5^{out}k_4^{in}}{m})+(0-\frac{k_5^{out}k_7^{in}}{m}) \\
&+(0-\frac{k_7^{out}k_7^{in}}{m})+(1-\frac{k_7^{out}k_4^{in}}{m})+(1-\frac{k_7^{out}k_5^{in}}{m})+(0-\frac{k_6^{out}k_6^{in}}{m})] \\
&= \frac{7}{27}
\end{aligned}$$

因此，模块度为 $\frac{7}{27}$