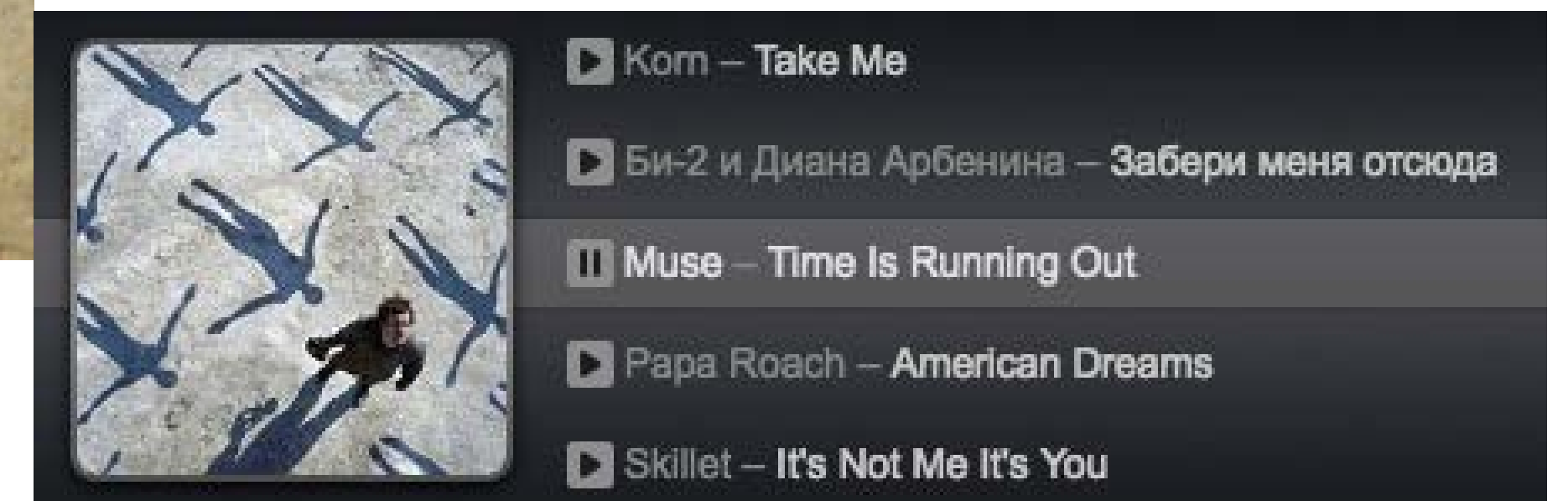


Graph based recommendations

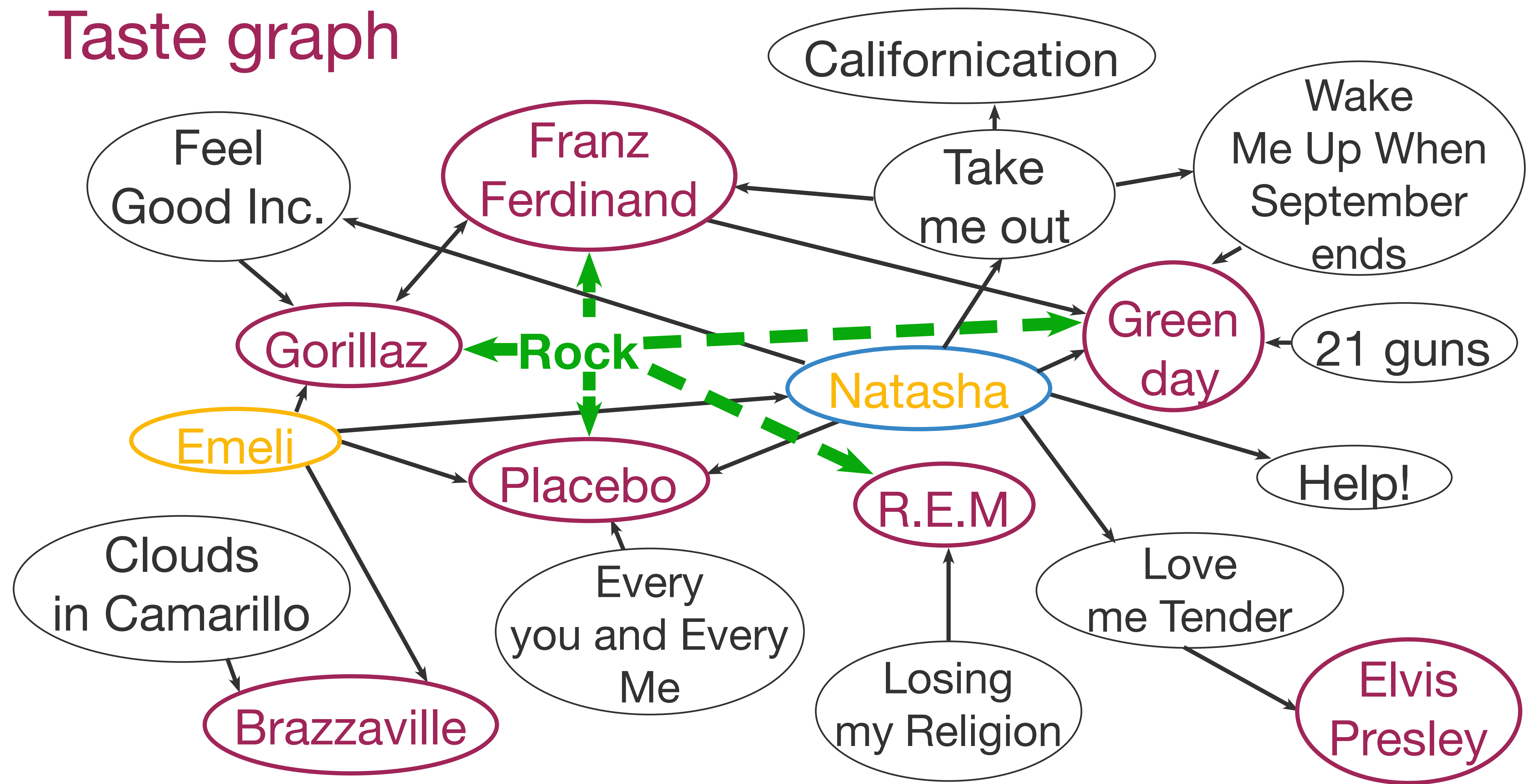
Generating recommendations



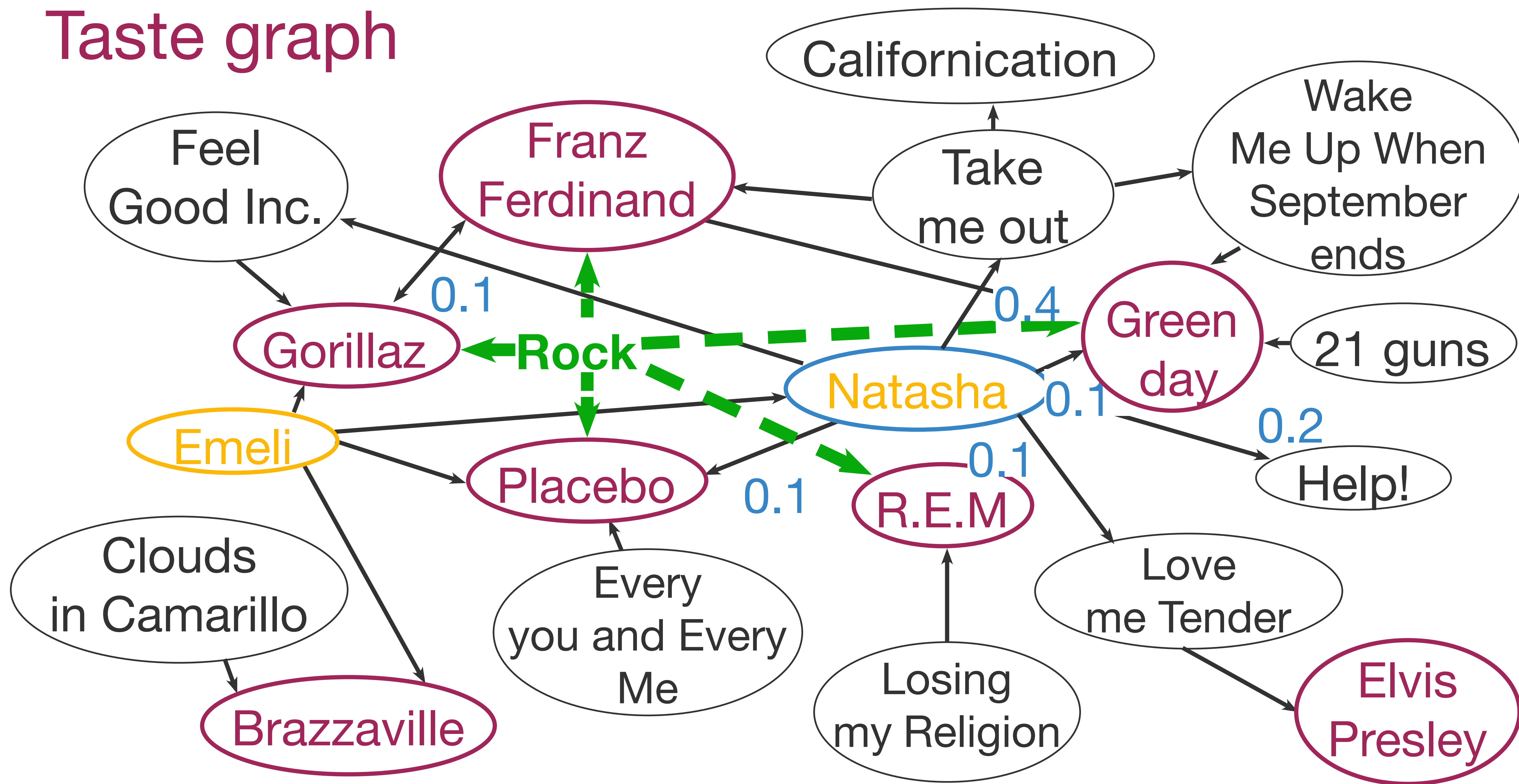
Generating recommendations



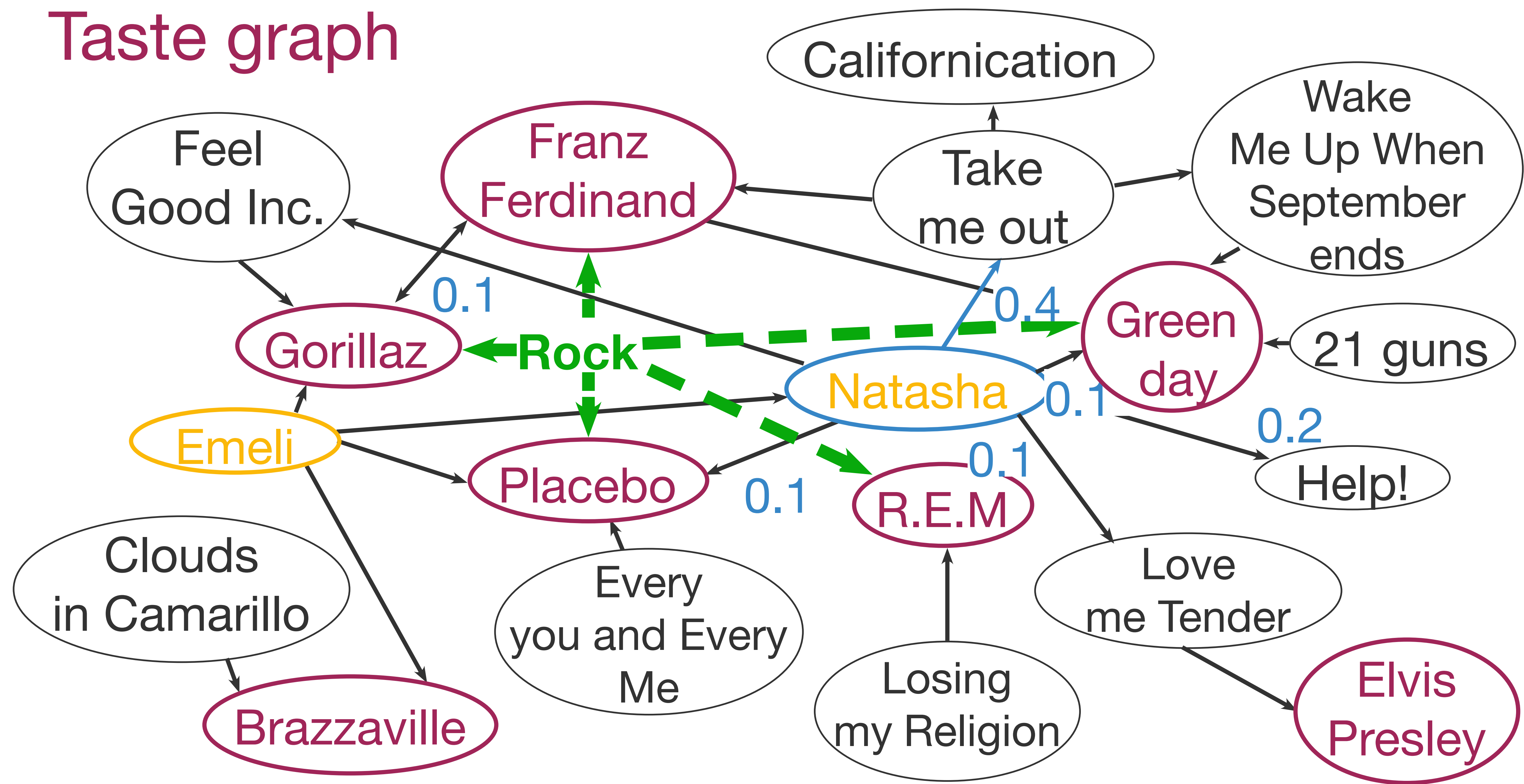
Taste graph



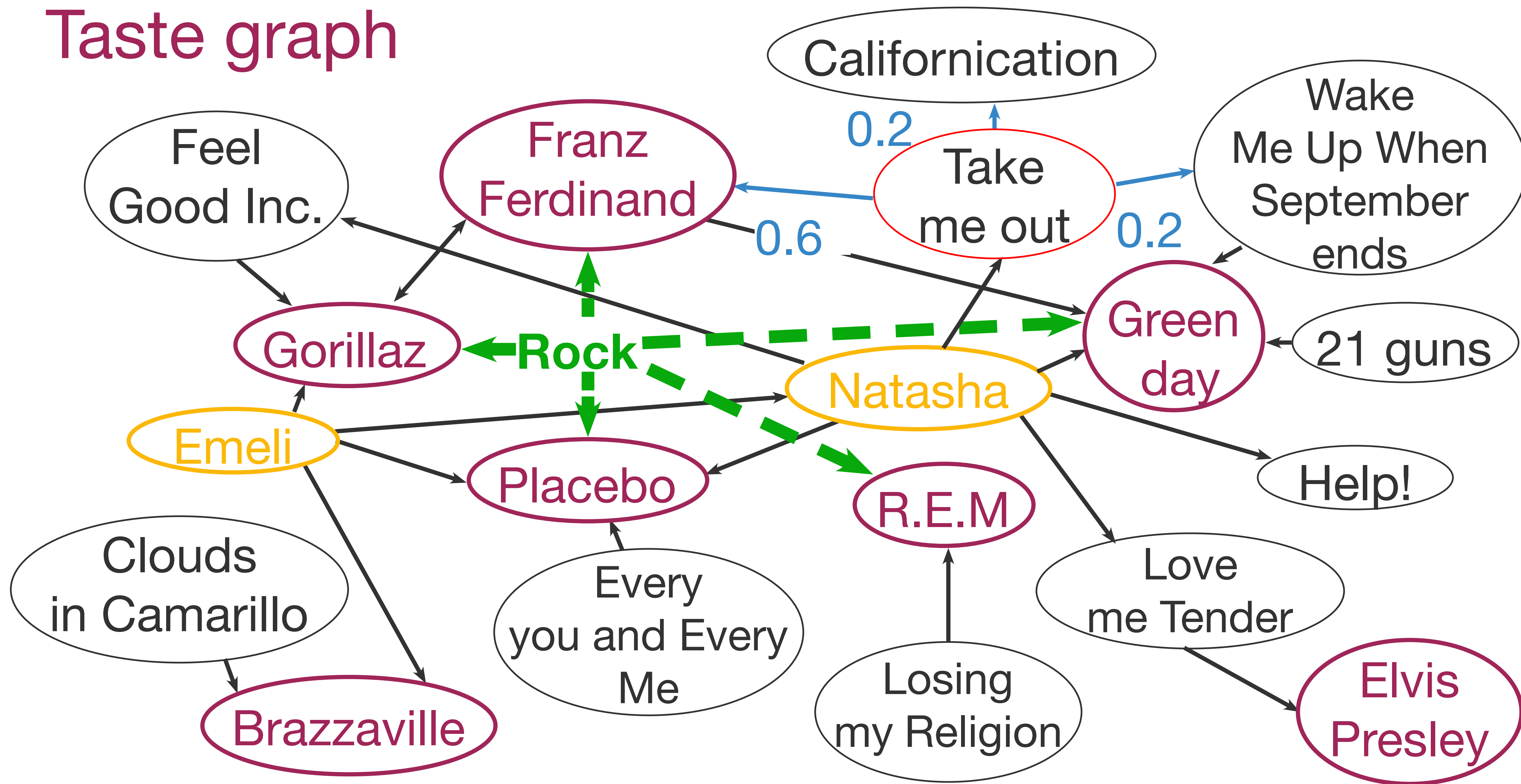
Taste graph



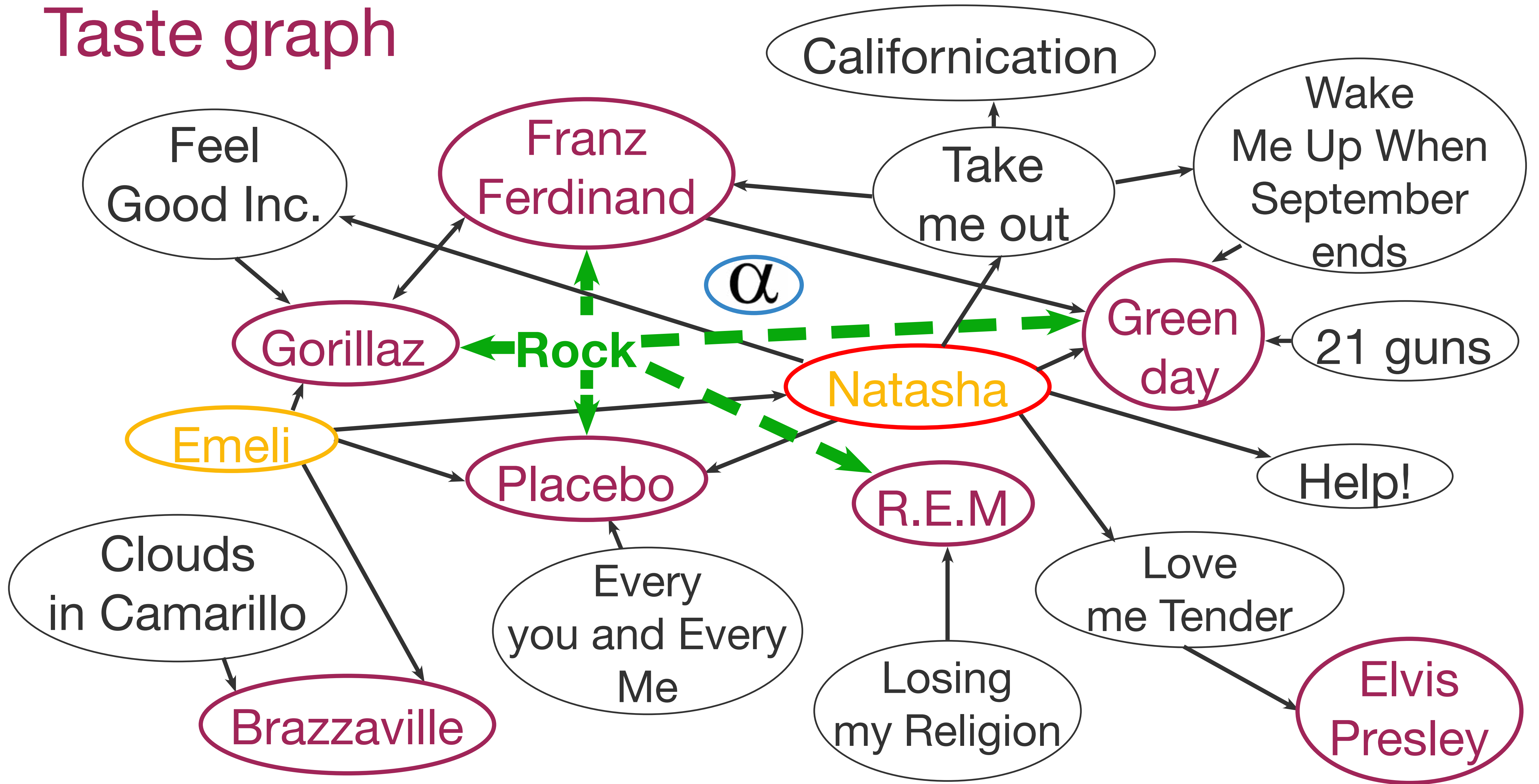
Taste graph



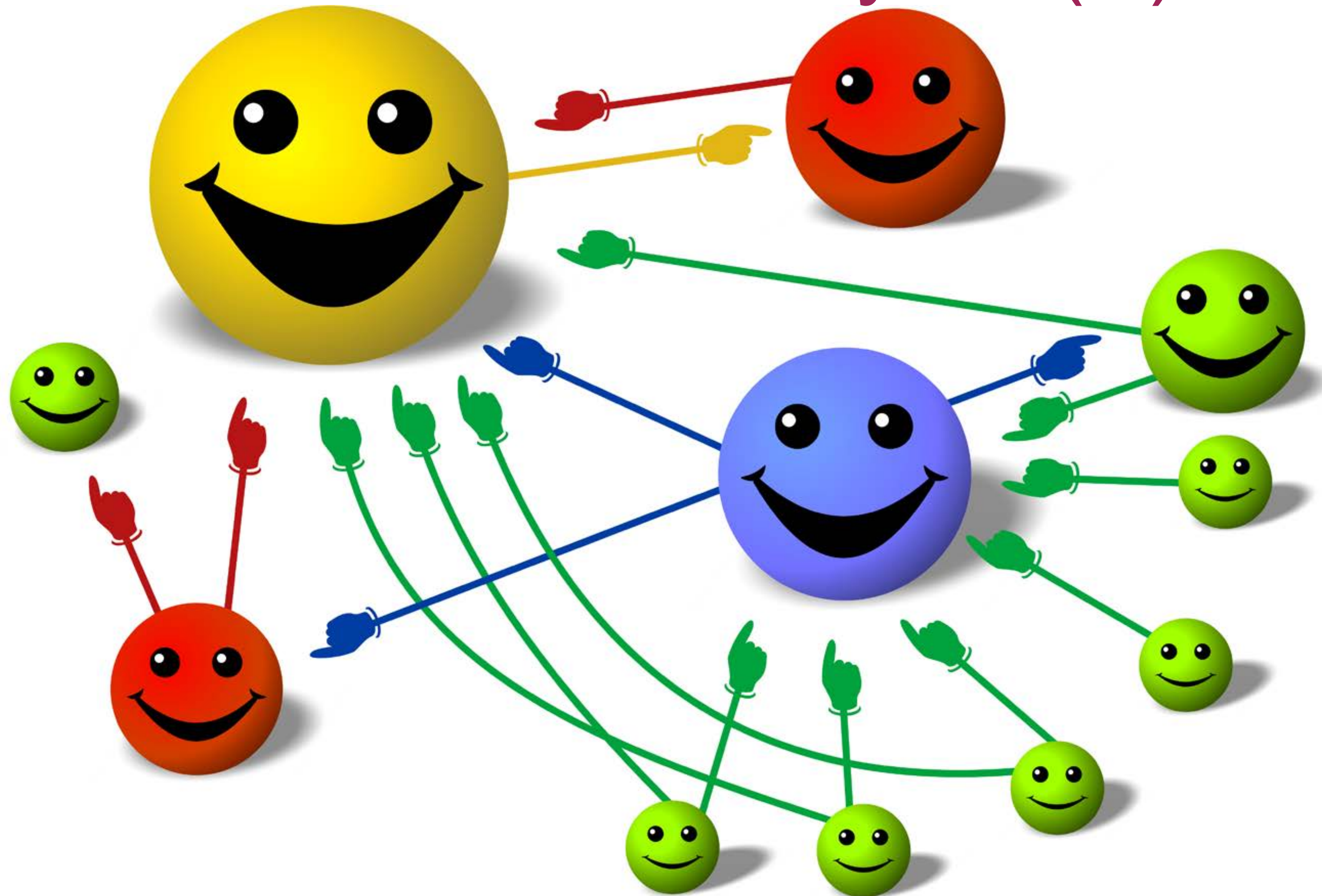
Taste graph



Taste graph



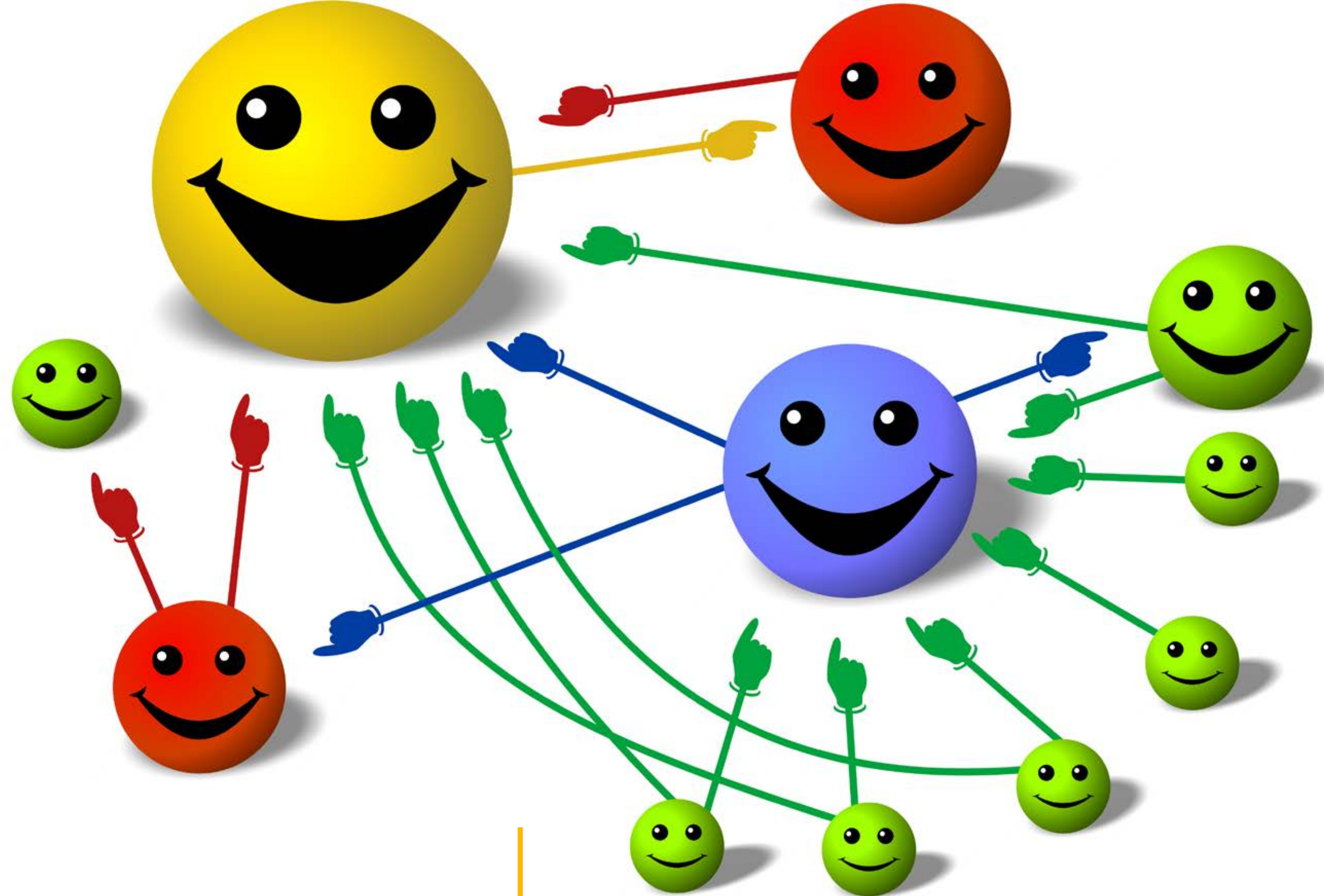
PageRank of E denoted by $PR(E)$





The probability that the person will continue surfing, at any step, is a damping factor d

$$d = 0.85$$



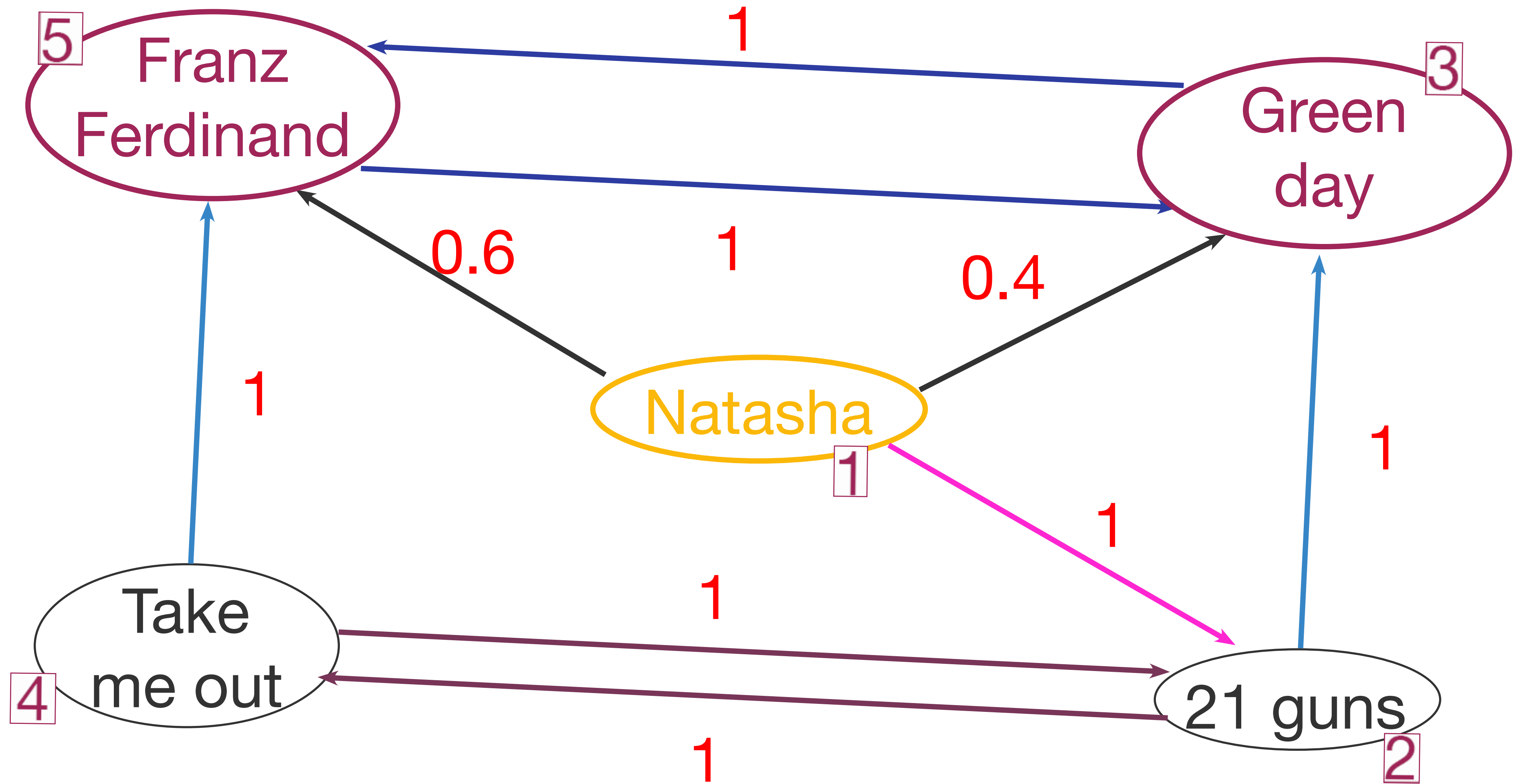
$$PR(A) = \frac{1-d}{N} + d \left(\frac{PR(B)}{L(B)} + \frac{PR(C)}{L(C)} + \frac{PR(D)}{L(D)} + \dots \right)$$

$$x = (x_1, x_2, \dots, x_{|V|}), \quad x_i \in [0, 1]$$

$$next(x) = \alpha * |u| + (1 - \alpha) * \sum_{v \in V} (x_v * next(v))$$

$$|u| = (0, \dots, 0_{u-1}, 1_u, 0_{u+1}, \dots, 0)$$

$$next(v) = \sum_{t_e \in T_E, e \in out(v, t_e)} \omega_\beta(e) * |second(R(e))|$$



$$x = (0.2, 0.2, 0.2, 0.2, 0.2),$$

$$|u| = (1, 0, 0, 0, 0, 0)$$

$$\alpha = 0.15$$

$$next(x) = \alpha * |u| + (1 - \alpha) * \sum_{v \in V} (x_v * next(v))$$

$$next(v) = \sum_{t_e \in T_E, e \in out(v, t_e)} \omega_\beta(e) * |second(R(e))|$$

$$w_\beta(e) = w(e) * \beta(\tau_v(first(R(e))), \tau_e(e))$$

Balancing function $\beta : T_V \times T_E \rightarrow [0, 1]$:

$$\beta(\text{user}, t_e) = \begin{cases} 0.4, & t_e = \text{user} \rightarrow \text{track}, \\ 0.6, & t_e = \text{user} \rightarrow \text{artist} \end{cases}$$

$$\beta(\text{artist}, t_e) = \begin{cases} 1, & t_e = \text{artist} \rightarrow \text{artist} \end{cases}$$

$$\beta(\text{track}, t_e) = \begin{cases} 0.3, & t_e = \text{track} \rightarrow \text{track}, \\ 0.7, & t_e = \text{track} \rightarrow \text{artist} \end{cases}$$

$$w_{\beta}(e) = w(e) * \beta(\tau_v(\text{first}(R(e))), \tau_e(e))$$

Balancing function $\beta : T_V \times T_E \rightarrow [0, 1]$:

$$\beta(\text{user}, t_e) = \begin{cases} 0.4, & t_e = \text{user} \rightarrow \text{track}, \\ 0.6, & t_e = \text{user} \rightarrow \text{artist} \end{cases}$$

$$\beta(\text{artist}, t_e) = \begin{cases} 1, & t_e = \text{artist} \rightarrow \text{artist} \end{cases}$$

$$\beta(\text{track}, t_e) = \begin{cases} 0.3, & t_e = \text{track} \rightarrow \text{track}, \\ 0.7, & t_e = \text{track} \rightarrow \text{artist} \end{cases}$$

$$\omega_{\beta}(\text{Natasha}, \text{Green day}) = 0.4 * \beta(\text{user}, \text{artist}) = 0.4 * 0.6 = 0.24$$

$$\omega_{\beta}(\text{Natasha}, \text{Franz Ferdinand}) = 0.6 * \beta(\text{user}, \text{artist}) = 0.6 * 0.6 = 0.36$$

$$w_{\beta}(e) = w(e) * \beta(\tau_v(\text{first}(R(e))), \tau_e(e))$$

Balancing function $\beta : T_V \times T_E \rightarrow [0, 1]$:

$$\beta(\text{user}, t_e) = \begin{cases} 0.4, & t_e = \text{user} \rightarrow \text{track}, \\ 0.6, & t_e = \text{user} \rightarrow \text{artist} \end{cases}$$

$$\beta(\text{artist}, t_e) = \begin{cases} 1, & t_e = \text{artist} \rightarrow \text{artist} \end{cases}$$

$$\beta(\text{track}, t_e) = \begin{cases} 0.3, & t_e = \text{track} \rightarrow \text{track}, \\ 0.7, & t_e = \text{track} \rightarrow \text{artist} \end{cases}$$

$$\omega_{\beta}(\text{Natasha}, 21 \text{ Guns}) = 1 * \beta(\text{user}, \text{artist}) = 1 * 0.4 = 0.4$$

$$next(v) = \sum_{t_e \in T_E, e \in out(v, t_e)} \omega_\beta(e) * |second(R(e))|$$

$$\omega_\beta(\text{Natasha, Green day}) = 0.24$$

$$\omega_\beta(\text{Natasha, Franz Ferdinand}) = 0.36$$

$$\omega_\beta(\text{Natasha, 21 Guns}) = 0.4$$

$$\begin{aligned} next(Natasha) &= 0.24 * |\text{Green day}| + 0.36 * |\text{Franz Ferdinand}| + 0.4 * |\text{21 Guns}| = \\ &= (0, 0.4, 0.24, 0, 0.36, 0) \end{aligned}$$

$$w_{\beta}(e) = w(e) * \beta(\tau_v(\text{first}(R(e))), \tau_e(e))$$

Balancing function $\beta : T_V \times T_E \rightarrow [0, 1]$:

$$\beta(\text{user}, t_e) = \begin{cases} 0.4, & t_e = \text{user} \rightarrow \text{track}, \\ 0.6, & t_e = \text{user} \rightarrow \text{artist} \end{cases}$$

$$\beta(\text{artist}, t_e) = \begin{cases} 1, & t_e = \text{artist} \rightarrow \text{artist} \end{cases}$$

$$\beta(\text{track}, t_e) = \begin{cases} 0.3, & t_e = \text{track} \rightarrow \text{track}, \\ 0.7, & t_e = \text{track} \rightarrow \text{artist} \end{cases}$$

$$\omega_{\beta}(\text{Franz Ferdinand}, \text{Green day}) = 1 * \beta(\text{artist}, \text{artist}) = 1 * 1 = 1$$

$$\omega_{\beta}(\text{Green day}, \text{Franz Ferdinand}) = 1 * \beta(\text{artist}, \text{artist}) = 1 * 1 = 1$$

$$next(v) = \sum_{t_e \in T_E, e \in out(v, t_e)} \omega_\beta(e) * |second(R(e))|$$

$$\omega_\beta(\text{Franz Ferdinand}, \text{Green day}) = 1$$

$$\begin{aligned} next(\text{Franz Ferdinand}) &= 1 * |\text{Green day}| = \\ &= (0, 0, 1, 0, 0) \end{aligned}$$

$$\omega_\beta(\text{Green day}, \text{Franz Ferdinand}) = 1$$

$$\begin{aligned} next(\text{Green day}) &= 1 * |\text{Franz Ferdinand}| = \\ &= (0, 0, 0, 1, 0) \end{aligned}$$

$$\beta(\text{user}, t_e) = \begin{cases} 0.4, & t_e = \text{user} \rightarrow \text{track}, \\ 0.6, & t_e = \text{user} \rightarrow \text{artist} \end{cases}$$

$$\beta(\text{artist}, t_e) = \begin{cases} 1, & t_e = \text{artist} \rightarrow \text{artist} \end{cases}$$

$$\beta(\text{track}, t_e) = \begin{cases} 0.3, & t_e = \text{track} \rightarrow \text{track}, \\ 0.7, & t_e = \text{track} \rightarrow \text{artist} \end{cases}$$

$$\omega_\beta(21 \text{ Guns, Green day}) = 1 * \beta(\text{artist}, \text{track}) = 1 * 0.7 = 0.7$$

$$\omega_\beta(21 \text{ Guns, Take me out}) = 1 * \beta(\text{artist}, \text{track}) = 1 * 0.3 = 0.3$$

$$next(v) = \sum_{t_e \in T_E, e \in out(v, t_e)} \omega_\beta(e) * |second(R(e))|$$

$$\omega_\beta(21 \text{ Guns, Green day}) = 0.7$$

$$\omega_\beta(21 \text{ Guns, Take me out}) = 0.3$$

$$\begin{aligned} next(21 \text{ Guns}) &= 0.7 * |\text{Green day}| + 0.3 * |\text{Take me out}| = \\ &= (0, 0, 0.7, 0.3, 0) \end{aligned}$$

$$\beta(\text{user}, t_e) = \begin{cases} 0.4, t_e = \text{user} \rightarrow \text{track}, \\ 0.6, t_e = \text{user} \rightarrow \text{artist} \end{cases}$$

$$\beta(\text{artist}, t_e) = \begin{cases} 1, t_e = \text{artist} \rightarrow \text{artist} \end{cases}$$

$$\beta(\text{track}, t_e) = \begin{cases} 0.3, t_e = \text{track} \rightarrow \text{track}, \\ 0.7, t_e = \text{track} \rightarrow \text{artist} \end{cases}$$

$$\omega_\beta(\text{Take me out, Franz Ferdinand}) = 1 * \beta(\text{artist}, \text{track}) = 1 * 0.7 = 0.7$$

$$\omega_\beta(\text{Take me out, 21 Guns}) = 1 * \beta(\text{artist}, \text{track}) = 1 * 0.3 = 0.3$$

$$next(v) = \sum_{t_e \in T_E, e \in out(v, t_e)} \omega_\beta(e) * |second(R(e))|$$

$$\omega_\beta(\text{Take me out, Franz Ferdinand}) = 0.7$$

$$\omega_\beta(\text{Take me out, 21 Guns}) = 0.3$$

$$\begin{aligned} next(\text{Take me out}) &= 0.7 * |\text{Franz Ferdinand}| + 0.3 * |\text{21 Guns}| = \\ &= (0, 0.3, 0, 0, 0.7) \end{aligned}$$

$$x = (0.2, 0.2, 0.2, 0.2, 0.2), \quad |u| = (1, 0, 0, 0, 0), \quad \alpha = 0.15$$

$$\text{next}(\text{Natasha}) = (0, 0.4, 0.24, 0, 0.36)$$

$$\text{next}(\text{Franz Ferdinand}) = (0, 0, 1, 0, 0), \quad \text{next}(\text{Green day}) = (0, 0, 0, 1, 0)$$

$$\text{next}(\text{21 Guns}) = (0, 0, 0.7, 0.3, 0), \quad \text{next}(\text{Take me out}) = (0, 0.3, 0, 0, 0.7)$$

$$\text{next}(x) = \alpha * |u| + (1 - \alpha) * \sum_{v \in V} (x_v * \text{next}(v)) =$$

$$= 0.15 * (1, 0, 0, 0, 0) + 0.85 * 0.2 * \text{next}(\text{Natasha}) +$$

$$+ 0.85 * 0.2 * \text{next}(\text{Franz Ferdinand}) + 0.85 * 0.2 * \text{next}(\text{Green day}) +$$

$$+ 0.85 * 0.2 * \text{next}(\text{21 Guns}) + 0.85 * 0.2 * \text{next}(\text{Take me out}) =$$

$$= (0.15, 0.119, 0.3298, 0.221, 0.1802)$$

Summary

- you learn how to solve the generating music recommendations task using the taste graph