**Mining Closed Sequential Patterns with Time Constraints**\*

**Table 1: Example the closed time-constrained sequential patterns.**

|  |  |  |
| --- | --- | --- |
| Sid | Sequence | Closed time-constrained sequential patterns  (*minsup =* 50%, *mingap* = 3, *maxgap* = 15, *swin* = 2) |
| C1 | <3(c)5(a, f)18(b)31(a)45(f)> | <(a)>:3, <(a, c)(b)>:2, <(b)>:3, <(b)(e)(d)>:2, <(c)>:3, <(c, d)>:2, <(d)>:3 |
| C2 | <6(a, c)10(b)17(e)24(c, d)> |
| C3 | <1(b)20(b, g)27(e)36(d)> |
| C4 | <5(a)10(d)21(c, d)> |

1. Find all frequent items:{a} : 3; {b} : 3; {c} : 3; {d} : 3; {e}:2

(Note here that {f}:1; {g}:1 are omitted)

2. With frequent items, generate 1-patterns:{{a}} ; {{b}} ; {{c}}; {{d}}

The time index records of 1-pattern {{a}} are shown in Table 2.

**Table 2: The time index records of 1-pattern {{a}}**

|  |  |  |
| --- | --- | --- |
| Sid | Sequence | Time index |
| C1 | <3(c)5(a, f)18(b)31(a)45(f)> | {a}-Tidx1 = {5:5; 31:31} |
| C2 | <6(a, c)10(b)17(e)24(c, d)> | {a}-Tidx2 = {6:6} |
| C4 | <5(a)10(d)21(c, d)> | {a}-Tidx4 = {5:5} |

Collect FEPs of type-1 and type-2 patterns

**Table 3: The FEPs and Stems of 1-pattern {{a}}**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Time index | FEPs type1 | Stem1 | FEP type2 | Stem2 |
| {a}-Tidx1 = {5 : 5; 31 : 31} | [8 ; 20] ;  [34 ; 46] | {b} : 1  {f} : 1 | [3 ; 7] ;  [29 ; 33] | {c} : 1  {a} : 2  {f} : 1 |
| {a}-Tidx2 = {6 : 6} | [9; 21] | {b} : 1  {e} : 1 | [4;8] | {a} : 1  {c} : 1 |
| {a}-Tidx4 = {5 : 5} | [8; 20] | {d} : 1 | [3;7] | {a} : 1 |

Stem1 = {{b} : 2} ; Stemp2 = {{c}:2}

Because support count of {b} and {c} are also not equal to support count of pattern {a}, so {a} is closed.

Backward checking valid for pattern {a}

**Table 4: The BEPs and Stems of 1-pattern {{a}}**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Time line | BEPs type1 | Stem1 | BEP type2 | Stem2 |
| {a}-Til1 = {5 : 5; 31 : 31} | [-10 ; 2] |  | [3 ; 5] or [5 ; 7]  [29 ; 31] or [31 ; 33] | {c} : 1  {a} : 2  {f} : 1 |
| {a}-Til2 = {6 : 6} | [-11 ; 3] |  | [4 ; 6] or [6 ; 8] | {a} : 1  {c} : 1 |
| {a}-Til4 = {5 : 5} | [-10 ; 2] |  | [3 ; 7] or [5 ; 7] | {a} : 1 |

Stemp2 = {{c}: 2}

Because support count of {c} is not equal to support count of pattern {a}, so {a} is closed.

After checking forward and backward, {a} is closed and we output {a}.

Continue the process with 2-pattern type1{{a}{b}} and type2 {a, c}

With {{a}{b}} : 2, construct P-Tidx for this pattern as shown in Table 5

**Table 5: The time index records of 1-pattern {{a}{b}}**

|  |  |  |
| --- | --- | --- |
| Sid | Sequence | Time index |
| C1 | <3(c)5(a, f)18(b)31(a)45(f)> | {a}-Tidx1 = {18:18} |
| C2 | <6(a, c)10(b)17(e)24(c, d)> | {a}-Tidx2 = {10:10} |

Collect FEPs of type-1 and type-2 patterns

**Table 6: The FEPs and Stems of 1-pattern {{a}{b}}**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Time index | FEPs type1 | Stem1 | FEP type2 | Stem2 |
| {a}-Tidx1 = {18 : 18} | [21 ; 33] | {a} : 1 | [16 ; 20] | {b} : 1 |
| {a}-Tidx2 = {10 : 10} | [13; 25] | {e} : 1 | [8 ; 12 ] | {b} : 1 |

Stemp2 = {{b}:2}

Because support count of {b} is equal to support count of pattern {{a}{b}}, so {{a}{b}} is not closed.

With {{a , c}} : 2, construct P-Tidx for this pattern as shown in Table 5

**Table 5: The time index records of 1-pattern {{a, c}**

|  |  |  |
| --- | --- | --- |
| Sid | Sequence | Time index |
| C1 | <3(c)5(a, f)18(b)31(a)45(f)> | {a}-Tidx1 = {18:18} |
| C2 | <6(a, c)10(b)17(e)24(c, d)> | {a}-Tidx2 = {10:10} |

Collect FEPs of type-1 and type-2 patterns

**Table 6: The FEPs and Stems of 1-pattern {{a}{b}}**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Time index | FEPs type1 | Stem1 | FEP type2 | Stem2 |
| {a}-Tidx1 = {18 : 18} | [21 ; 33] | {a} : 1 | [16 ; 20] | {b} : 1 |
| {a}-Tidx2 = {10 : 10} | [13; 25] | {e} : 1 | [8 ; 12 ] | {b} : 1 |

Stemp2 = {{b}:2}

Because support count of {b} is equal to support count of pattern {{a}{b}}, so {{a}{b}} is not closed.