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**Algorithm 1:** Goal Model Update Algorithm - Check Function

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**Input** :  $r$ : goal/task that executed event refers to;  $M$ : marking

**Output:** Updated marking  $M$   $J$

```
1 Check( $r, M$ ) if  $type(r)$  is goal then
2   |  $M^G(r) \leftarrow achieved$ ;
3 else
4   | if  $type(r)$  is task then
5     |  $M^T(r) \leftarrow activated$ ;
6   | end
7 end
8 foreach  $p$  in  $parents(r)$  do
9   |  $M^L((p, r)) \leftarrow activated$ ;
10  | if  $type(p)$  is quality then
11    | if  $contrib\_type(r, p)$  is "MAKE" then
12      |  $M^Q(p) \leftarrow fulfilled$ ;
13    | else if  $contrib\_type(r, p)$  is "BREAK" then
14      |  $M^Q(p) \leftarrow denied$ ;
15    | end
16    | if  $M^Q(p)$  is fulfilled then
17      | Backprop Fulfilled: ( $p, M, ;$ 
18      | )
19    | else if  $M^Q(p)$  is denied then
20      | Backprop Denied: ( $p, M, ;$ 
21      | )
22    | end
23  | else
24    | if  $ref\_type(p)$  is "OR" then
25      | if  $type(p)$  is goal then
26        |  $M^G(p) \leftarrow achieved$ ;
27      | else
28        | if  $type(p)$  is task then
29          |  $M^T(p) \leftarrow activated$ ;
30        | end
31      | end
32    | else if  $ref\_type(p)$  is "AND" then
33      | all_activated  $\leftarrow$  true;
34      | foreach  $c$  in  $children(p)$  do
35        | if  $M^L((p, c))$  is not activated then
36          | all_activated  $\leftarrow$  false;
37          | break;
38        | end
39      | end
40      | if  $type(p)$  is goal then
41        |  $M^G(p) \leftarrow$  all_activated ? achieved : partially_achieved;
42      | else
43        | if  $type(p)$  is task then
44          |  $M^T(p) \leftarrow$  all_activated ? activated : partially_activated;
45        | end
46      | end
47    | end
48    | Check( $p, M$ );
49  | end
50 end
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**Algorithm 2:** Goal Model Update Algorithm - BackpropFulfilled Function

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```
1 BackpropFulfilled( $q, M$ ) foreach  $c$  in  $children(q)$  do
2   if  $contrib\_type((c, q))$  is “BREAK” and  $M^L((c, q))$  is activated then
3      $M^L((c, q)) \leftarrow deactivated$ ;
4     if  $type(c)$  is goal then
5        $M^G(c) \leftarrow deactivated$ ;
6     else
7       if  $type(c)$  is task then
8          $M^T(c) \leftarrow deactivated$ ;
9       end
10    end
11    foreach  $gc$  in  $children(c)$  do
12      if  $M^L((c, gc))$  is activated then
13         $M^L((c, gc)) \leftarrow deactivated$ ;
14         $Check(gc, M)$ ;
15      end
16    end
17  end
18 end
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**Algorithm 3:** Goal Model Update Algorithm - BackpropDenied Function

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```
1 BackpropDenied( $q, M$ ) foreach  $c$  in  $children(q)$  do
2   if  $contrib\_type((c, q))$  is “MAKE” and  $M^L((c, q))$  is activated then
3      $M^L((c, q)) \leftarrow deactivated$ ;
4     if  $type(c)$  is goal then
5        $M^G(c) \leftarrow deactivated$ ;
6     else
7       if  $type(c)$  is task then
8          $M^T(c) \leftarrow deactivated$ ;
9       end
10    end
11    foreach  $gc$  in  $children(c)$  do
12      if  $M^L((c, gc))$  is activated then
13         $M^L((c, gc)) \leftarrow deactivated$ ;
14         $Check(gc, M)$ ;
15      end
16    end
17  end
18 end
```

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