Algorithm 1: Goal Model Update Algorithm - Check Function

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) ← achieved;
3  else
4  |  if type(r) is task then
5  |  |  M^T(r) ← activated;
6  |  end
7  end
8  foreach p in parents(r) do
9  |  M^L((p, r)) ← activated;
10 |  if type(p) is quality then
11 |  |  if contrib_type(r,p) is "MAKE" then
12 |  |  |  M^Q(p) ← fulfilled;
13 |  |  else if contrib_type(r,p) is "BREAK" then
14 |  |  |  M^Q(p) ← 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) ← achieved;
27 |  |  |  else
28 |  |  |  |  if type(p) is task then
29 |  |  |  |  |  M^T(p) ← activated;
30 |  |  |  |  end
31 |  |  |  end
32 |  |  else if ref_type(p) is "AND" then
33 |  |  |  all_activated ← true;
34 |  |  |  foreach c in children(p) do
35 |  |  |  |  if M^L((p, c)) is not activated then
36 |  |  |  |  |  all_activated ← false;
37 |  |  |  |  |  break;
38 |  |  |  |  end
39 |  |  |  end
40 |  |  |  if type(p) is goal then
41 |  |  |  |  M^G(p) ← all_activated ? achieved : partially_achieved;
42 |  |  |  else
43 |  |  |  |  if type(p) is task then
44 |  |  |  |  |  M^T(p) ← all_activated ? activated : partially_activated;
45 |  |  |  |  end
46 |  |  |  end
47 |  |  end
48 |  |  Check(p, M);
49 |  end
50 end
```

Algorithm 2: Goal Model Update Algorithm - BackpropFulfilled Function

```
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)) ← deactivated;
4          if type(c) is goal then
5              M^G(c) ← deactivated;
6          else
7              if type(c) is task then
8                  M^T(c) ← 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)) ← deactivated;
14                 Check(gc, M);
15             end
16         end
17     end
18 end
```

Algorithm 3: Goal Model Update Algorithm - BackpropDenied Function

```
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)) ← deactivated;
4          if type(c) is goal then
5              M^G(c) ← deactivated;
6          else
7              if type(c) is task then
8                  M^T(c) ← 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)) ← deactivated;
14                 Check(gc, M);
15             end
16         end
17     end
18 end
```