actor YCrCbtoRGB()
  int(size=10) Y, int(size=10) Cr, int(size=10) Ch ⇒
  int(size=8) R, int(size=8) G, int(size=8) B :

  int(size=13) rv = 292;
  int(size=13) gu = 101;
  int(size=13) gv = 149;
  int(size=13) bu = 520;
  int(size=11) t1 := 1023;

  action
    Y: [y], Cr: [cr], Ch: [cb] ⇒
    R: [r], G: [g], B: [b]
  var
    int(size=10) r, int(size=10) g, int(size=10) b, int(size=10) rt,
    int(size=10) gt, int(size=10) bt, int(size=11) yt, int(size=11) crt,
    int(size=11) cbt
  do
    // signed to unsigned representation
    yt := bitand(y, t1);
    crt := bitand(cr, t1);
    cbt := bitand(cbt, t1);
    // core algorithm
    rt := (((yt−64) << 8) + rv*(crt−512)) >> 10;
    gt := (((yt−64) << 8) − gu*(cbt−512) − gv*(crt−512)) >> 10;
    bt := (((yt−64) << 8) + bu*(cbt−512)) >> 10;
    // clip output r
    if (rt > 0) then
      if (rt < 255) then r := rt;
      else r := 255; end
    else r := 0; end
    // clip output g
    if (gt > 0) then
      if (gt < 255) then g := gt;
      else g := 255; end
    else g := 0; end
    // clip output b
    if (bt > 0) then
      if (bt < 255) then b := bt;
      else b := 255; end
    else b := 0; end
  end
end

Figure 3: CAL actor example–actor YCrCbtoRGB

graph of this transformation is given in figure 4. Twenty extra variables (zt1 to z20) are introduced to represent intermediate results of thirty-five operations.

The remainder of this section provides relations, graphs, and algorithms that define pipeline synthesis and optimization problem from a generic dataflow graph, with an example using the graph of figure 4.

4.2 Dataflow Graph Relations

4.2.1 Operator Precedence Relation on Dataflow Graph

Let N = {1, . . . , n} be a set of algorithm operators and M = {1, . . . , m} be a set of algorithm variables. The following matrices describe operator-variable and precedence relations.

1. The operators/input variables relation. The operators / input variables relation is described with the F(n, m) matrix:

   \[ F = \begin{bmatrix}
   f_{1,1} & \cdots & f_{1,m} \\
   \vdots & \ddots & \vdots \\
   f_{n,1} & \cdots & f_{n,m}
   \end{bmatrix} \]