Pensieve header: AutoAd for AoBranch. Branched from pensieve://Projects/OneCo-1604/.

```
SetDirectory["C:\\drorbn\\AcademicPensieve\\Projects\\OneCo-1604\\AoBranch"];
<< Local.m
```

```
In the U(T)⊗U(H) conventions and with
   renormalized arrows at 1co level. Internal use symbols: {rr, pp}
```

Export

```
AutoAd[B_, x_][y_] :=
  Module[{pows, states, i, s, seq, sh = 5, dseq, sf1, sf2, sf, t1, n},
   pows = NestList[B[x, #] &, y, 20];
   states = Union[Cases[pows,
      s_β | s_δβ | s_a | s_c | s_ao | s_ca | s_aao :> ReplacePart[s, 1 → _], ∞]];
   UU@Sum[
     seq = Cases[{#}, states[[i]], ∞] & /@ pows;
     seq = Replace[seq, {{_[f_, ___]} :> f, {} → 0}, {1}];
     dseq = Drop[seq, sh];
     If[Union[Length[MonomialList[#]] & /@ dseq] === {1} ⋀
       Union[Length[FactorTermsList[#]] & /@ dseq] === {2},
      sf1 = FindSequenceFunction[FactorTermsList[#][[1]] & /@ dseq];
      sf2 = FindSequenceFunction[FactorTermsList[#][[2]] & /@ dseq];
      sf = (sf1[#] sf2[#] &),
      (*Else*) sf = FindSequenceFunction[dseq,
        FunctionSpace → {"ConstantRecursive", "HolonomicSequence",
          "Polynomial", "RationalFunction", "HypergeometricTerm"}]];
     ReplacePart[states[[i]], 1 → FullSimplify[ Sum[seq[[n + 1]]/n!, {n, 0, sh - 1}] + Sum[sf[n + 1 - sh]/n!, {n, sh, ∞}]]],
     {i, Length@states}]];
```

```
t1 = AutoAd[bb[j, k], UU@a[t, j, k]][UU@a[1, j, h∞]]
```

$$UU\left[a[1, j, h\infty] + aao\left[-\frac{-1 + e^{-t\, b_j} + t\, b_j}{b_j^2}, j, h\infty, j, k\right] + ca[-t, k, j, h\infty] + ca\left[\frac{1 - e^{-t\, b_j}}{b_j}, h\infty, j, k\right]\right]$$

```
t2 = AutoAd[bb[j, k], UU@a[t, j, k]][UU@a[1, k, h∞]]
```

$$\begin{aligned}&UU\Big[a\Big[e^{t\,b_j},\ k,\ h\infty\Big] + a\Big[-\frac{\left(-1+e^{t\,b_j}\right)b_k}{b_j},\ j,\ h\infty\Big] + aao\Big[\frac{1+e^{t\,b_j}\,(-1+t\,b_j)}{b_j^2},\ j,\ h\infty,\ k,\ k\Big] +\\ &\quad aao\Big[\frac{1}{b_j^3}e^{-t\,b_j}\left(b_j+e^{2\,t\,b_j}\,(b_j+(2-t\,b_j)\,b_k)-e^{t\,b_j}\,(2\,b_k+b_j\,(2+t\,b_k))\right),\ j,\ h\infty,\ j,\ k\Big] +\\ &\quad ao\Big[\frac{\left(-1+e^{t\,b_j}\,(1-t\,b_j)\right)b_k}{b_j^2},\ j,\ h\infty\Big] + ca\Big[\frac{-1+e^{-t\,b_j}}{b_j},\ h\infty,\ j,\ k\Big] +\\ &\quad ca\Big[-\frac{b_k-e^{t\,b_j}\,(b_j+b_k)+b_j\,(1+t\,b_k)}{b_j^2},\ k,\ j,\ h\infty\Big]\Big]\end{aligned}$$

HeadByTails

```
AutoAd[bb[j, k], UU@a[1, j, k]][UU@a[1, 0, j]]
```

HeadByTails

$$\begin{aligned}&UU\Big[a[1,\ 0,\ j] + a\Big[1-e^{-b_j},\ 0,\ k\Big] + a\Big[\frac{\left(-1+e^{-b_j}\right)b_0}{b_j},\ j,\ k\Big] +\\ &\quad aao\Big[\frac{2\,e^{-b_j}\,b_0\,(\text{Sinh}[b_j]-b_j)}{b_j^3},\ j,\ k,\ j,\ k\Big] + aao\Big[\frac{-1+e^{-b_j}+b_j}{b_j^2},\ 0,\ j,\ j,\ k\Big] +\\ &\quad aao\Big[\frac{e^{-2\,b_j}\left(1+e^{2\,b_j}\,(-1+b_j)+e^{b_j}\,b_j\right)}{b_j^2},\ 0,\ k,\ j,\ k\Big] +\\ &\quad ao\Big[\frac{e^{-b_j}\,b_0\left(-1+e^{b_j}-b_j\right)}{b_j^2},\ j,\ k\Big] + ca[1,\ k,\ 0,\ j] + ca\Big[1+\frac{-1+e^{-b_j}}{b_j},\ k,\ 0,\ k\Big] +\\ &\quad ca\Big[\frac{e^{-b_j}\,b_0\left(-1+e^{b_j}-b_j\right)}{b_j^2},\ k,\ j,\ k\Big] + ca\Big[\frac{-1+e^{-b_j}}{b_j},\ j,\ 0,\ k\Big]\Big]\end{aligned}$$

HeadByHeads

```
AutoAd[bb[j, k], UU@a[1, j, k]][UU@a[1, 0, k]]
```

HeadByHeads

$$\begin{aligned}&UU\Big[a\Big[e^{-b_j},\ 0,\ k\Big] + a\Big[\frac{\left(1-e^{-b_j}\right)b_0}{b_j},\ j,\ k\Big] +\\ &\quad aao\Big[\frac{e^{-2\,b_j}\left(-1-e^{b_j}\,(-1+b_j)\right)}{b_j^2},\ 0,\ k,\ j,\ k\Big] + aao\Big[\frac{2\,e^{-b_j}\,b_0\,(-\text{Sinh}[b_j]+b_j)}{b_j^3},\ j,\ k,\ j,\ k\Big] +\\ &\quad ao\Big[-\frac{e^{-b_j}\,b_0\left(-1+e^{b_j}-b_j\right)}{b_j^2},\ j,\ k\Big] + ca\Big[-\frac{e^{-b_j}\,b_0\left(-1+e^{b_j}-b_j\right)}{b_j^2},\ k,\ j,\ k\Big]\Big]\end{aligned}$$