Betterplot

```
In[∘]:= Betterplot::usage = "Betterplot[{eq__},{x,min,max},{y,min,max}]";

In[∘]:= CircleForm[eq_] := Block[{cof = Echo[Coefficient[eq, #, 2] & /@ Variables[eq], "Coefficients"]},
          If[cof ≠ ConstantArray[cof[[1]], Length@cof], Print["coefficients not same"]];
          Echo[Transpose[{(x - h) ^ 2 + (y - k) ^ 2 == r ^ 2,
              If[0 == Expand[cof[[1]] ((x - h) ^ 2 + (y - k) ^ 2 - r ^ 2) - eq], "True"]} /.
            SolveAlways[eq / cof[[1]] == (x - h) ^ 2 + (y - k) ^ 2 - r ^ 2, {x, y}]]]][[1]][[1]]

       DiscontinuityPoints[eq_, var1_, var2_, var_ : x] :=
        Module[{ineq = FunctionDiscontinuities[eq, var], a},
         a = InequalitiesToIntervals[Check[SolveValues[ineq && var1 ≤ var ≤ var2, var, Reals],
            Reduce[ineq && var1 ≤ var ≤ var2, var, Reals]], var];
         Select[{#, eq /. var → #} & /@ Flatten[a[[#]] & /@ Range[Length[a]]],
          {True, True} === Internal`RealValuedNumericQ /@ # &]]

       InequalitiesToIntervals[ineq_, x_] :=
         LogicalExpand[ineq] /. {Greater[x, foo_] → Interval[{foo, Infinity}],
           Greater[foo_, x] → Interval[{-Infinity, foo}], GreaterEqual[x, foo_] →
            Interval[{foo, Infinity}], GreaterEqual[foo_, x] → Interval[{-Infinity, foo}],
           Less[x, foo_] → Interval[{-Infinity, foo}], Less[foo_, x] → Interval[{foo, Infinity}],
           LessEqual[x, foo_] → Interval[{-Infinity, foo}], LessEqual[foo_, x] →
            Interval[{foo, Infinity}], Or → IntervalUnion, And → IntervalIntersection};

In[∘]:= Options[Betterplot] = Join[Options[ContourPlot], {"Asymptote" → True, "N" → False,
          "TP" → True, "Time" → 7, "IP" → True, "Endpoints" → True, PlotPoints → 50}];

       Betterplot[{eqint__}, dom : {_, _?NumericQ, _?NumericQ} : {x, -10, 10},
         ran : {_, _?NumericQ, _?NumericQ} : {y, -10, 10}, opts : OptionsPattern[]] :=
        TimeConstrained[Quiet@Module[{pairs, Tp, graphintercepts, xintercepts, hp, yintercepts,
            endpoints, midpoints, op, asymp, VAsymp, HAsymp, OAsymp, h, k, r, c1, C1Asymp,
            negx, posx, posy, negy, l, time = OptionValue["Time"], oip, ihp, IP, complex, eq},
          complex =
           Transpose@Table[Module[{a, eq1, trans, final},
              If[Length@Variables[First[ieq]] === 0, eq1 = Last[ieq] == First[ieq], eq1 = ieq];
              Which[Exponent[First[eq1], z] === 1, trans = {0, 0}, Length[First[eq1] // First] ≠ 2,
               trans = {0, 0}, True, trans = ReIm@First@First@First[eq1]];
              final = {(dom[[1]] + trans[[1]])^2 + (ran[[1]] + trans[[2]])^2 ==
                  ((Abs[Last[eq1]])^(1/Exponent[First[eq1],z]))^2, Button[Tooltip@#, Print[#]] & /@
                  FromPolarCoordinates /@ AbsArg /@ SolveValues[ieq, z]}],
             {ieq, Select[{eqint}, Variables[First[Normal@#] - Last[Normal@#]][[1]] === z &]}];

          eq = Sequence[Sequence @@
             Select[Normal[{eqint}], Variables[First[Normal@#] - Last[Normal@#]][[1]] =!= z &]];
          pairs = Subsets[{eq}, {2}];
          If[OptionValue["N"],
           graphintercepts = Select[Normal@Table[
               TimeConstrained[
                NSolveValues[Join[i, {dom[[2]] ≤ dom[[1]] ≤ dom[[3]]}], {dom[[1]], ran[[1]]}, Reals], 8],
               {i, pairs}], UnsameQ[#, {}] &];
           xintercepts = Select[Flatten[{#, 0}] & /@ # & /@ Select[Normal@Table[
                 TimeConstrained[Check[NSolveValues[
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            {i /. ran[[1]] → 0, dom[[2]] ≤ dom[[1]] ≤ dom[[3]]}, dom[[1]], Reals], {l}], 7],
        {i, {eq}}], UnsameQ[#, {}] &], Flatten[#][[1]] =!= l &];
yintercepts = Select[Flatten[{0, #}] & /@ # & /@ Select[Normal@Table[
        TimeConstrained[Check[NSolveValues[
            {i /. dom[[1]] → 0, ran[[2]] ≤ ran[[1]] ≤ ran[[3]]}, ran[[1]], Reals], {l}], 7],
        {i, {eq}}], UnsameQ[#, {}] &], Flatten[#][[2]] =!= l &];
negx = Select[Flatten[{dom[[2]], #} & /@ # & /@ Select[Normal@Table[
         TimeConstrained[Check[NSolveValues[{i /. dom[[1]] → dom[[2]],
             ran[[2]] ≤ ran[[1]] ≤ ran[[3]]}, ran[[1]], Reals], {l}], 7],
         {i, {eq}}], UnsameQ[#, {}] &], 1], #[[2]] =!= l &];
posx = Select[Flatten[{dom[[3]], #} & /@ # & /@ Select[Normal@Table[
         TimeConstrained[Check[NSolveValues[{i /. dom[[1]] → dom[[3]],
             ran[[2]] ≤ ran[[1]] ≤ ran[[3]]}, ran[[1]], Reals], {l}], 7],
         {i, {eq}}], UnsameQ[#, {}] &], 1], #[[2]] =!= l &];
negy = Select[Flatten[{#, ran[[2]]} & /@ # & /@ Select[Normal@Table[
         TimeConstrained[Check[SolveValues[{i /. ran[[1]] → ran[[2]],
             dom[[2]] ≤ dom[[1]] ≤ dom[[3]]}, dom[[1]], Reals], {l}], 7],
         {i, {eq}}], UnsameQ[#, {}] &], 1], #[[1]] =!= l &];
posy = Select[Flatten[{#, ran[[3]]} & /@ # & /@ Select[Normal@Table[
         TimeConstrained[Check[SolveValues[{i /. ran[[1]] → ran[[3]],
             dom[[2]] ≤ dom[[1]] ≤ dom[[3]]}, dom[[1]], Reals], {l}], 7],
         {i, {eq}}], UnsameQ[#, {}] &], 1], #[[1]] =!= l &];


,
graphintercepts = Select[Normal@Table[
      TimeConstrained[SolveValues[Join[i, {dom[[2]] ≤ dom[[1]] ≤ dom[[3]]}],
        {dom[[1]], ran[[1]]}, Reals], time, TimeConstrained[
        NSolveValues[Join[i, {dom[[2]] ≤ dom[[1]] ≤ dom[[3]]}], {dom[[1]], ran[[1]]}, Reals], 8]],
      {i, pairs}], UnsameQ[#, {}] &];
xintercepts = Select[Flatten[{#, 0}] & /@ # & /@ Select[Normal@Table[
        TimeConstrained[Check[SolveValues[{i /. ran[[1]] → 0, dom[[2]] ≤ dom[[1]] ≤ dom[[3]]},
            dom[[1]], Reals], {l}], time, TimeConstrained[Check[NSolveValues[
             {i /. ran[[1]] → 0, dom[[2]] ≤ dom[[1]] ≤ dom[[3]]}, dom[[1]], Reals], {l}], 7]],
        {i, {eq}}], UnsameQ[#, {}] &], Flatten[#][[1]] =!= l &];
yintercepts = Select[Flatten[{0, #}] & /@ # & /@ Select[Normal@Table[
        TimeConstrained[Check[SolveValues[{i /. dom[[1]] → 0, ran[[2]] ≤ ran[[1]] ≤ ran[[3]]},
            ran[[1]], Reals], {l}], time, TimeConstrained[Check[NSolveValues[
             {i /. dom[[1]] → 0, ran[[2]] ≤ ran[[1]] ≤ ran[[3]]}, ran[[1]], Reals], {l}], 7]],
        {i, {eq}}], UnsameQ[#, {}] &], Flatten[#][[2]] =!= l &];
negx = Select[Flatten[{dom[[2]], #} & /@ # & /@ Select[Normal@Table[
         TimeConstrained[Check[SolveValues[{i /. dom[[1]] → dom[[2]], ran[[2]] ≤ ran[[1]] ≤ ran[[3]]},
             1]], Reals], {l}], time, TimeConstrained[Check[NSolveValues[
             {i /. dom[[1]] → dom[[2]], ran[[2]] ≤ ran[[1]] ≤ ran[[3]]}, ran[[1]], Reals], {l}], 7]],
         {i, {eq}}], UnsameQ[#, {}] &], 1], #[[2]] =!= l &];
posx = Select[Flatten[{dom[[3]], #} & /@ # & /@ Select[Normal@Table[
         TimeConstrained[Check[SolveValues[{i /. dom[[1]] → dom[[3]], ran[[2]] ≤ ran[[1]] ≤ ran[[3]]},
             1]], Reals], {l}], time, TimeConstrained[Check[NSolveValues[
             {i /. dom[[1]] → dom[[3]], ran[[2]] ≤ ran[[1]] ≤ ran[[3]]}, ran[[1]], Reals], {l}], 7]],
         {i, {eq}}], UnsameQ[#, {}] &], 1], #[[2]] =!= l &];
negy = Select[Flatten[{#, ran[[2]]} & /@ # & /@ Select[Normal@Table[
         TimeConstrained[Check[SolveValues[{i /. ran[[1]] → ran[[2]], dom[[2]] ≤ dom[[1]] ≤ dom[[3]]},
             1]], Reals], {l}], time, TimeConstrained[Check[SolveValues[
             {i /. ran[[1]] → ran[[2]], dom[[2]] ≤ dom[[1]] ≤ dom[[3]]}, dom[[1]], Reals], {l}], 7]],
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            {i, {eq}}], UnsameQ[#, {}] &], 1], #[[1]] =!= l &];
    posy = Select[Flatten[{#, ran[[3]]} & /@ # & /@ Select[Normal@Table[
            TimeConstrained[Check[SolveValues[{i /. ran[[1]] → ran[[3]], dom[[2]] ≤ dom[[1]] ≤ dom[[3]]},
                1]], Reals], {l}], time, TimeConstrained[Check[SolveValues[
                {i /. ran[[1]] → ran[[3]], dom[[2]] ≤ dom[[1]] ≤ dom[[3]]}, dom[[1]], Reals], {l}], 7]],
            {i, {eq}}], UnsameQ[#, {}] &], 1], #[[1]] =!= l &];
   ];
   If[OptionValue["Endpoints"],
    endpoints = If[Not@ContainsAny[#, {∞, -∞}], #, ## &[]] & /@
        DiscontinuityPoints[#, dom[[2]], dom[[3]], dom[[1]]] & /@
      Flatten[SolveValues[#, ran[[1]]] & /@
        Select[{eq}, Exponent[First[Normal@#] - Last[Normal@#], dom[[1]]] ≠ 2 &&
            Exponent[First[Normal@#] - Last[Normal@#], ran[[1]]] ≠ 2 &]], endpoints = {}];

   midpoints = Lookup[Association[SolveAlways[First[
            QuietEcho[CircleForm[Expand[First[#] - Last[#]]]]] == (x - h) ^2 + (y - k) ^2 - r^2, {x, 
      {h, k}] & /@ Select[{eq}, Exponent[First[Normal@#] - Last[Normal@#], dom[[1]]] == 2 &&
        Exponent[First[Normal@#] - Last[Normal@#], ran[[1]]] == 2 &];

   If[OptionValue["Asymptote"],
    asymp = Lookup[Merge[
       OperatorApplied[ResourceFunctionHelpers`Asymptotes, {3, 1, 2}][dom[[1]]][ran[[1]]]
        /@ ReplaceAll[Rule → Equal][
         Flatten[Solve[#, ran[[1]]] & /@
           Select[{eq}, (Exponent[First[Normal@#] - Last[Normal@#], dom[[1]]] ≠ 2) ||
              (Exponent[First[Normal@#] - Last[Normal@#], ran[[1]]] ≠ 2) &]]]
      , Identity], {"Vertical", "Horizontal", "Oblique"}];

    VAsymp =
     If[Not@MissingQ[asymp[[1]]], DeleteDuplicates[Merge[Evaluate[asymp[[1]] // Flatten] /.
          x___ ± y_ :> Sequence @@ {(x + y), (x - y)}, Identity][dom[[1]]]], {}];
 HAsymp = If[Not@MissingQ[asymp[[2]]], DeleteDuplicates[Merge[Evaluate[asymp[[2]] // Flatten] /.
          x___ ± y_ :> Sequence @@ {(x + y), (x - y)}, Identity][ran[[1]]]], {}];
 OAsymp = If[Not@MissingQ[asymp[[3]]], DeleteDuplicates[Merge[Evaluate[asymp[[3]] // Flatten] /.
          x___ ± y_ :> Sequence @@ {(x + y), (x - y)}, Identity][ran[[1]]]], {}];
    C1Asymp = If[Length@Select[VAsymp, Variables[{#}] == {c1} &] > 0, Flatten[Reap[
        Table[Sow[Table[Evaluate[c1 /. c1 :> x], {x, Ceiling[SolveValues[c1 == dom[[2]], c1]][[1]],
             Floor[SolveValues[c1 == dom[[3]], c1]][[1]]}]],
          {c1, Select[VAsymp, Variables[{#}] == {c1} &]}] // Last]], {}];
    VAsymp = Select[VAsymp, Variables[{#}] ≠ {c1} &],
    VAsymp = {}; HAsymp = {}; OAsymp = {}; C1Asymp = {}];
   If[OptionValue["TP"],

    If[OptionValue["N"],
     Tp = Flatten[
       Table[Module[{z = {dom[[1]], Sequence @@ NSolveValues[n, ran[[1]]]} /. NSolve[{SolveValues[
                Dt[n, dom[[1]]], Dt[ran[[1]], dom[[1]]]] == 0, dom[[2]] ≤ dom[[1]] ≤ dom[[3]]}, dom[[1]]]},
         If[ContainsAny[z, {dom[[1]]}] || Not@ContainsAny[Flatten[Length[#] ≠ 2 & /@ z],
            {False}], ## &[], z]], {n, {eq}}], 1],
     Tp = Flatten[
       Table[Module[{z = {dom[[1]], Sequence @@ SolveValues[n, ran[[1]]]} /. Solve[{SolveValues[
                Dt[n, dom[[1]]], Dt[ran[[1]], dom[[1]]]] == 0, dom[[2]] ≤ dom[[1]] ≤ dom[[3]]}, dom[[1]]]},
         If[ContainsAny[z, {dom[[1]]}] || Not@ContainsAny[Flatten[Length[#] ≠ 2 & /@ z],
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            {False}], ## &[], z]], {n, {eq}}], 1]];
  op = Normal[Select[Tp, Variables[{Normal[#[[1]]]}] == {c1} &]];
  hp = Flatten[
     Table[Table[Evaluate[c1 /. c1 :> x], {x, Ceiling[SolveValues[c1[[1]] == dom[[2]], c1]][[1]],
        Floor[SolveValues[c1[[1]] == dom[[3]], c1]][[1]]}], {c1, op}], 1] // DeleteDuplicates;
  Tp = Normal[Select[Tp, Variables[{Normal[#[[1]]]}] ≠ {c1} &]], Tp = {};
  hp = {}

 ];
 If[OptionValue["IP"], If[OptionValue["N"],
   IP = Flatten[Table[Module[{z = {dom[[1]], Sequence @@ NSolveValues[n, ran[[1]]]} /.
          NSolve[{SolveValues[Dt[n, {dom[[1]], 2}], Dt[ran[[1]], {dom[[1]], 2}]] ==
             0, dom[[2]] ≤ dom[[1]] ≤ dom[[3]]}, dom[[1]]]}, If[ContainsAny[z, {dom[[1]]}] || Not@
          ContainsAny[Flatten[Length[#] ≠ 2 & /@ z], {False}], ## &[], z]], {n, {eq}}], 1],
   IP = Flatten[Table[Module[{z = {dom[[1]], Sequence @@ SolveValues[n, ran[[1]]]} /.
          Solve[{SolveValues[Dt[n, {dom[[1]], 2}], Dt[ran[[1]], {dom[[1]], 2}]] == 0, dom[[2]] ≤
             dom[[1]] ≤ dom[[3]]}, dom[[1]]]}, If[ContainsAny[z, {dom[[1]]}] || Not@
          ContainsAny[Flatten[Length[#] ≠ 2 & /@ z], {False}], ## &[], z]], {n, {eq}}], 1]
  ];
  oip = Normal[Select[IP, Variables[{Normal[#[[1]]]}] == {c1} &]];
  ihp = Flatten[
     Table[Table[Evaluate[c1 /. c1 :> x], {x, Ceiling[SolveValues[c1[[1]] == dom[[2]], c1]][[1]],
        Floor[SolveValues[c1[[1]] == dom[[3]], c1]][[1]]}], {c1, oip}], 1] // DeleteDuplicates;
  IP = Normal[Select[IP, Variables[{Normal[#[[1]]]}] ≠ {c1} &]
   ]];
 Show[{
   ContourPlot[{eqint}, dom, ran,
    Evaluate[FilterRules[{opts}, Options[ContourPlot]]], PlotRange → Full,
    Axes → True, AxesLabel → {Row[{"ℝ | ", dom[[1]]}], Row[{"Im | ", ran[[1]]}]},
    PlotLegends → "Expressions", Frame → False, Ticks → Automatic,
    GridLines → Automatic, PlotPoints → OptionValue[PlotPoints]],

   If[Not[complex === {}],
    Sequence @@ {ContourPlot[Evaluate[complex[[1]]], dom, ran, ContourStyle → Dashed],
      ListPlot[complex[[2]], PlotMarkers → {Automatic, 7}]}, ## &[]]
   ,

   Sequence @@ If[OptionValue["N"],
     {
      ListPlot[Button[Tooltip@#, Print[#]] & /@
         N@DeleteDuplicates@Join[Sequence @@ xintercepts, Sequence @@ yintercepts],
       PlotStyle → {Black}, PlotMarkers → {Automatic, 5}],
      ListPlot[Button[Tooltip@#, Print[#]] & /@ N@Flatten[DeleteDuplicates@
           graphintercepts, 1], PlotStyle → {Blue}, PlotMarkers → {Automatic, 5}],
      ListPlot[Button[Tooltip@#, Print[#]] & /@ N@DeleteDuplicates@midpoints,
       PlotStyle → {Brown}, PlotMarkers → {Automatic, 5}],
      ListPlot[Button[Tooltip@#, Print[#]] & /@
         N@Part[DeleteDuplicates[{Flatten[{posx, negx, posy, negy}, 1]}], 1],
       PlotStyle → {Gray}, PlotMarkers → {Automatic, 5}],
      ListPlot[Button[Tooltip@#, Print[#]] & /@
         N@Flatten[DeleteDuplicates[Select[endpoints, UnsameQ[#, {}] &]], 1],
       PlotStyle → {Red}, PlotMarkers → {Automatic, 5}]
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        },
        {
         ListPlot[Button[Tooltip@#, Print[#]] & /@
           DeleteDuplicates@Join[Sequence @@ xintercepts, Sequence @@ yintercepts],
          PlotStyle → {Black}, PlotMarkers → {Automatic, 5}],
         ListPlot[Button[Tooltip@#, Print[#]] & /@ Flatten[DeleteDuplicates@graphintercepts,
            1], PlotStyle → {Blue}, PlotMarkers → {Automatic, 5}],
         ListPlot[Button[Tooltip@#, Print[#]] & /@ DeleteDuplicates@midpoints,
          PlotStyle → {Brown}, PlotMarkers → {Automatic, 5}],
         ListPlot[Button[Tooltip@#, Print[#]] & /@
           Part[DeleteDuplicates[{Flatten[{posx, negx, posy, negy}, 1]}], 1],
          PlotStyle → {Gray}, PlotMarkers → {Automatic, 5}],
         ListPlot[Button[Tooltip@#, Print[#]] & /@
           Flatten[DeleteDuplicates[Select[endpoints, UnsameQ[#, {}] &]], 1],
          PlotStyle → {Green}, PlotMarkers → {Automatic, 5}]
        }
       ]
      , If[OptionValue["IP"],
       ListPlot[Button[Tooltip@#, Print[#]] & /@ Complement[Join[IP, ihp], Join[Tp, hp]],
        PlotStyle → {Magenta}, PlotMarkers → {Automatic, 5}], ## &[]],
      If[OptionValue["TP"], ListPlot[Button[Tooltip@#, Print[#]] & /@ Join[Tp, hp],
        PlotStyle → {Red}, PlotMarkers → {Automatic, 5}], ## &[]],
      If[
       OptionValue["Asymptote"] && Length[Flatten@Join[HAsymp, OAsymp, C1Asymp, VAsymp]] ≠ 0,
       ContourPlot[
        Evaluate[
         Join[
          If[Length[VAsymp] ≠ 0 || Length[C1Asymp] ≠ 0,
           dom⟦1⟧ == # & /@ DeleteDuplicates[Join[VAsymp, C1Asymp]],
           ## &[]]
          , If[Length[Join[HAsymp, OAsymp]] ≠ 0,
           ran⟦1⟧ == # & /@ Join[HAsymp, OAsymp],
           ## &[]]
         ]
        ],
        dom, ran, ContourStyle → Directive[Orange, Thick, Dashed]], ## &[]]
     }]], 22]
```

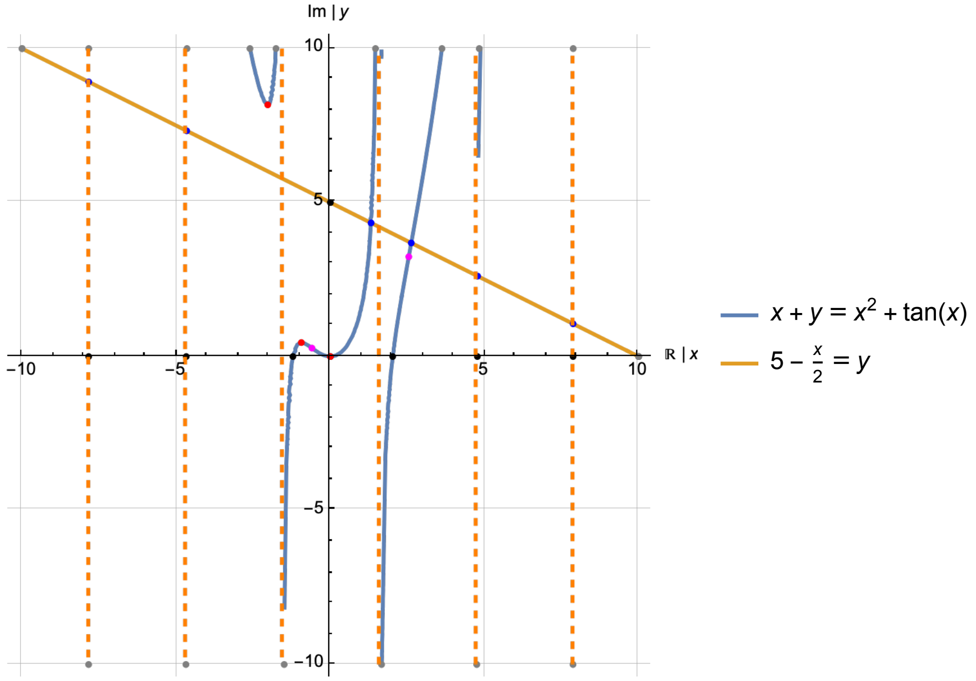
In[◦]:=

```
SetAttributes[Betterplot, HoldFirst]
```

Examples

In[ ]:=
```
Betterplot[{y + x == x^2 + Tan[x], 5 - x / 2 == y}]
```

Out[ ]=



In[ ]:=
```
Betterplot[{(z - I + 1) ^4 == 3 + 2 I}, {x, -5, 5}, {y, -5, 5}]
```

Out[ ]=