

# Twitter Sentiment Analysis

Nathaniel Aldino, Daniel Arvelo, Matias Cintera, Devin Parmet,  
Raymond Gillies

# Problem/Objective

- In our project, we aimed to evaluate text data by generating a model that can determine the emotion portrayed by the text in question. This is a popular machine learning technique and is more commonly known as sentiment analysis.
- Why is this useful?
- Some examples of using sentiment analysis on text data could be to obtain insight on customer feedback for a particular product or service, or determine whether certain posts from a user on a social media platform are deemed appropriate or not.
- We perform sentiment analysis on Tweets (posts on the social media platform, Twitter, from users on the platform) to determine the emotion being portrayed by the user through that post.
- We built a Simple Recurrent Neural Network in Keras and a web application in Flask for our Demo.

# Data

- *Tweet Emotion Intensity Dataset* used in WASSA-2017 Shared Task on Emotion Intensity\* by Saif M. Mohammad and Felipe Bravo-Marquez
- The dataset is structured as: id[tab]tweet[tab]emotion[tab]score
  - Each tweet has a rating from 0 to 1 that measures the intensity of the specific emotion
  - The dataset is divided into a training set, development set, and a test set for each of the four emotions (anger, fear, joy, sadness)
- For each emotion, all tweets with a score  $> 0.59$  were used in our training set. For the testing set, the top 79 intensities were used in our testing set.
  - 79 was the maximum number of tweets for joy therefore was set as our emotion dataset maximum

\*WASSA-2017 Shared Task on Emotion Intensity. Saif M. Mohammad and Felipe Bravo-Marquez. In Proceedings of the EMNLP 2017 Workshop on Computational Approaches to Subjectivity, Sentiment, and Social Media (WASSA), September 2017, Copenhagen, Denmark.

```

30000 Just got back from seeing @GaryDelaney in Burslem. AMAZING!! Face still hurts from laughing so much #hilarious joy 0.980
30001 Oh dear an evening of absolute hilarity I don't think I have laughed so much in a long time! 0.958
30002 Been waiting all week for this game @M1,@M2,@M3,@M4,@M5,@M6,@M7,@M8,@M9,@M10,@M11,@M12,@M13,@M14,@M15,@M16,@M17,@M18,@M19,@M20,@M21,@M22,@M23,@M24,@M25,@M26,@M27,@M28,@M29,@M30,@M31,@M32,@M33,@M34,@M35,@M36,@M37,@M38,@M39,@M40,@M41,@M42,@M43,@M44,@M45,@M46,@M47,@M48,@M49,@M50,@M51,@M52,@M53,@M54,@M55,@M56,@M57,@M58,@M59,@M60,@M61,@M62,@M63,@M64,@M65,@M66,@M67,@M68,@M69,@M70,@M71,@M72,@M73,@M74,@M75,@M76,@M77,@M78,@M79,@M80,@M81,@M82,@M83,@M84,@M85,@M86,@M87,@M88,@M89,@M90,@M91,@M92,@M93,@M94,@M95,@M96,@M97,@M98,@M99,@M100,@M101,@M102,@M103,@M104,@M105,@M106,@M107,@M108,@M109,@M110,@M111,@M112,@M113,@M114,@M115,@M116,@M117,@M118,@M119,@M120,@M121,@M122,@M123,@M124,@M125,@M126,@M127,@M128,@M129,@M130,@M131,@M132,@M133,@M134,@M135,@M136,@M137,@M138,@M139,@M140,@M141,@M142,@M143,@M144,@M145,@M146,@M147,@M148,@M149,@M150,@M151,@M152,@M153,@M154,@M155,@M156,@M157,@M158,@M159,@M160,@M161,@M162,@M163,@M164,@M165,@M166,@M167,@M168,@M169,@M170,@M171,@M172,@M173,@M174,@M175,@M176,@M177,@M178,@M179,@M180,@M181,@M182,@M183,@M184,@M185,@M186,@M187,@M188,@M189,@M190,@M191,@M192,@M193,@M194,@M195,@M196,@M197,@M198,@M199,@M200,@M201,@M202,@M203,@M204,@M205,@M206,@M207,@M208,@M209,@M210,@M211,@M212,@M213,@M214,@M215,@M216,@M217,@M218,@M219,@M220,@M221,@M222,@M223,@M224,@M225,@M226,@M227,@M228,@M229,@M230,@M231,@M232,@M233,@M234,@M235,@M236,@M237,@M238,@M239,@M240,@M241,@M242,@M243,@M244,@M245,@M246,@M247,@M248,@M249,@M250,@M251,@M252,@M253,@M254,@M255,@M256,@M257,@M258,@M259,@M260,@M261,@M262,@M263,@M264,@M265,@M266,@M267,@M268,@M269,@M270,@M271,@M272,@M273,@M274,@M275,@M276,@M277,@M278,@M279,@M280,@M281,@M282,@M283,@M284,@M285,@M286,@M287,@M288,@M289,@M290,@M291,@M292,@M293,@M294,@M295,@M296,@M297,@M298,@M299,@M300,@M301,@M302,@M303,@M304,@M305,@M306,@M307,@M308,@M309,@M310,@M311,@M312,@M313,@M314,@M315,@M316,@M317,@M318,@M319,@M320,@M321,@M322,@M323,@M324,@M325,@M326,@M327,@M328,@M329,@M330,@M331,@M332,@M333,@M334,@M335,@M336,@M337,@M338,@M339,@M340,@M341,@M342,@M343,@M344,@M345,@M346,@M347,@M348,@M349,@M350,@M351,@M352,@M353,@M354,@M355,@M356,@M357,@M358,@M359,@M360,@M361,@M362,@M363,@M364,@M365,@M366,@M367,@M368,@M369,@M370,@M371,@M372,@M373,@M374,@M375,@M376,@M377,@M378,@M379,@M380,@M381,@M382,@M383,@M384,@M385,@M386,@M387,@M388,@M389,@M390,@M391,@M392,@M393,@M394,@M395,@M396,@M397,@M398,@M399,@M400,@M401,@M402,@M403,@M404,@M405,@M406,@M407,@M408,@M409,@M410,@M411,@M412,@M413,@M414,@M415,@M416,@M417,@M418,@M419,@M420,@M421,@M422,@M423,@M424,@M425,@M426,@M427,@M428,@M429,@M430,@M431,@M432,@M433,@M434,@M435,@M436,@M437,@M438,@M439,@M440,@M441,@M442,@M443,@M444,@M445,@M446,@M447,@M448,@M449,@M450,@M451,@M452,@M453,@M454,@M455,@M456,@M457,@M458,@M459,@M460,@M461,@M462,@M463,@M464,@M465,@M466,@M467,@M468,@M469,@M470,@M471,@M472,@M473,@M474,@M475,@M476,@M477,@M478,@M479,@M480,@M481,@M482,@M483,@M484,@M485,@M486,@M487,@M488,@M489,@M490,@M491,@M492,@M493,@M494,@M495,@M496,@M497,@M498,@M499,@M500,@M501,@M502,@M503,@M504,@M505,@M506,@M507,@M508,@M509,@M510,@M511,@M512,@M513,@M514,@M515,@M516,@M517,@M518,@M519,@M520,@M521,@M522,@M523,@M524,@M525,@M526,@M527,@M528,@M529,@M530,@M531,@M532,@M533,@M534,@M535,@M536,@M537,@M538,@M539,@M540,@M541,@M542,@M543,@M544,@M545,@M546,@M547,@M548,@M549,@M550,@M551,@M552,@M553,@M554,@M555,@M556,@M557,@M558,@M559,@M560,@M561,@M562,@M563,@M564,@M565,@M566,@M567,@M568,@M569,@M570,@M571,@M572,@M573,@M574,@M575,@M576,@M577,@M578,@M579,@M580,@M581,@M582,@M583,@M584,@M585,@M586,@M587,@M588,@M589,@M590,@M591,@M592,@M593,@M594,@M595,@M596,@M597,@M598,@M599,@M600,@M601,@M602,@M603,@M604,@M605,@M606,@M607,@M608,@M609,@M610,@M611,@M612,@M613,@M614,@M615,@M616,@M617,@M618,@M619,@M620,@M621,@M622,@M623,@M624,@M625,@M626,@M627,@M628,@M629,@M630,@M631,@M632,@M633,@M634,@M635,@M636,@M637,@M638,@M639,@M640,@M641,@M642,@M643,@M644,@M645,@M646,@M647,@M648,@M649,@M650,@M651,@M652,@M653,@M654,@M655,@M656,@M657,@M658,@M659,@M660,@M661,@M662,@M663,@M664,@M665,@M666,@M667,@M668,@M669,@M670,@M671,@M672,@M673,@M674,@M675,@M676,@M677,@M678,@M679,@M680,@M681,@M682,@M683,@M684,@M685,@M686,@M687,@M688,@M689,@M690,@M691,@M692,@M693,@M694,@M695,@M696,@M697,@M698,@M699,@M700,@M701,@M702,@M703,@M704,@M705,@M706,@M707,@M708,@M709,@M710,@M711,@M712,@M713,@M714,@M715,@M716,@M717,@M718,@M719,@M720,@M721,@M722,@M723,@M724,@M725,@M726,@M727,@M728,@M729,@M730,@M731,@M732,@M733,@M734,@M735,@M736,@M737,@M738,@M739,@M740,@M741,@M742,@M743,@M744,@M745,@M746,@M747,@M748,@M749,@M750,@M751,@M752,@M753,@M754,@M755,@M756,@M757,@M758,@M759,@M760,@M761,@M762,@M763,@M764,@M765,@M766,@M767,@M768,@M769,@M770,@M771,@M772,@M773,@M774,@M775,@M776,@M777,@M778,@M779,@M780,@M781,@M782,@M783,@M784,@M785,@M786,@M787,@M788,@M789,@M790,@M791,@M792,@M793,@M794,@M795,@M796,@M797,@M798,@M799,@M800,@M801,@M802,@M803,@M804,@M805,@M806,@M807,@M808,@M809,@M810,@M811,@M812,@M813,@M814,@M815,@M816,@M817,@M818,@M819,@M820,@M821,@M822,@M823,@M824,@M825,@M826,@M827,@M828,@M829,@M830,@M831,@M832,@M833,@M834,@M835,@M836,@M837,@M838,@M839,@M840,@M841,@M842,@M843,@M844,@M845,@M846,@M847,@M848,@M849,@M850,@M851,@M852,@M853,@M854,@M855,@M856,@M857,@M858,@M859,@M860,@M861,@M862,@M863,@M864,@M865,@M866,@M867,@M868,@M869,@M870,@M871,@M872,@M873,@M874,@M875,@M876,@M877,@M878,@M879,@M880,@M881,@M882,@M883,@M884,@M885,@M886,@M887,@M888,@M889,@M890,@M891,@M892,@M893,@M894,@M895,@M896,@M897,@M898,@M899,@M900,@M901,@M902,@M903,@M904,@M905,@M906,@M907,@M908,@M909,@M910,@M911,@M912,@M913,@M914,@M915,@M916,@M917,@M918,@M919,@M920,@M921,@M922,@M923,@M924,@M925,@M926,@M927,@M928,@M929,@M930,@M931,@M932,@M933,@M934,@M935,@M936,@M937,@M938,@M939,@M940,@M941,@M942,@M943,@M944,@M945,@M946,@M947,@M948,@M949,@M950,@M951,@M952,@M953,@M954,@M955,@M956,@M957,@M958,@M959,@M960,@M961,@M962,@M963,@M964,@M965,@M966,@M967,@M968,@M969,@M970,@M971,@M972,@M973,@M974,@M975,@M976,@M977,@M978,@M979,@M980,@M981,@M982,@M983,@M984,@M985,@M986,@M987,@M988,@M989,@M990,@M991,@M992,@M993,@M994,@M995,@M996,@M997,@M998,@M999,@M1000
30003 @gardiner_love : Thank you so much, Gloria! You're so sweet, and thoughtful! You just made my day more joyful! I love you too! 0.938
30004 I feel so blessed to work with the family that I nanny for @M1,@M2,@M3,@M4,@M5,@M6,@M7,@M8,@M9,@M10,@M11,@M12,@M13,@M14,@M15,@M16,@M17,@M18,@M19,@M20,@M21,@M22,@M23,@M24,@M25,@M26,@M27,@M28,@M29,@M30,@M31,@M32,@M33,@M34,@M35,@M36,@M37,@M38,@M39,@M40,@M41,@M42,@M43,@M44,@M45,@M46,@M47,@M48,@M49,@M50,@M51,@M52,@M53,@M54,@M55,@M56,@M57,@M58,@M59,@M60,@M61,@M62,@M63,@M64,@M65,@M66,@M67,@M68,@M69,@M70,@M71,@M72,@M73,@M74,@M75,@M76,@M77,@M78,@M79,@M80,@M81,@M82,@M83,@M84,@M85,@M86,@M87,@M88,@M89,@M90,@M91,@M92,@M93,@M94,@M95,@M96,@M97,@M98,@M99,@M100,@M101,@M102,@M103,@M104,@M105,@M106,@M107,@M108,@M109,@M110,@M111,@M112,@M113,@M114,@M115,@M116,@M117,@M118,@M119,@M120,@M121,@M122,@M123,@M124,@M125,@M126,@M127,@M128,@M129,@M130,@M131,@M132,@M133,@M134,@M135,@M136,@M137,@M138,@M139,@M140,@M141,@M142,@M143,@M144,@M145,@M146,@M147,@M148,@M149,@M150,@M151,@M152,@M153,@M154,@M155,@M156,@M157,@M158,@M159,@M160,@M161,@M162,@M163,@M164,@M165,@M166,@M167,@M168,@M169,@M170,@M171,@M172,@M173,@M174,@M175,@M176,@M177,@M178,@M179,@M180,@M181,@M182,@M183,@M184,@M185,@M186,@M187,@M188,@M189,@M190,@M191,@M192,@M193,@M194,@M195,@M196,@M197,@M198,@M199,@M200,@M201,@M202,@M203,@M204,@M205,@M206,@M207,@M208,@M209,@M210,@M211,@M212,@M213,@M214,@M215,@M216,@M217,@M218,@M219,@M220,@M221,@M222,@M223,@M224,@M225,@M226,@M227,@M228,@M229,@M230,@M231,@M232,@M233,@M234,@M235,@M236,@M237,@M238,@M239,@M240,@M241,@M242,@M243,@M244,@M245,@M246,@M247,@M248,@M249,@M250,@M251,@M252,@M253,@M254,@M255,@M256,@M257,@M258,@M259,@M260,@M261,@M262,@M263,@M264,@M265,@M266,@M267,@M268,@M269,@M270,@M271,@M272,@M273,@M274,@M275,@M276,@M277,@M278,@M279,@M280,@M281,@M282,@M283,@M284,@M285,@M286,@M287,@M288,@M289,@M290,@M291,@M292,@M293,@M294,@M295,@M296,@M297,@M298,@M299,@M300,@M301,@M302,@M303,@M304,@M305,@M306,@M307,@M308,@M309,@M310,@M311,@M312,@M313,@M314,@M315,@M316,@M317,@M318,@M319,@M320,@M321,@M322,@M323,@M324,@M325,@M326,@M327,@M328,@M329,@M330,@M331,@M332,@M333,@M334,@M335,@M336,@M337,@M338,@M339,@M340,@M341,@M342,@M343,@M344,@M345,@M346,@M347,@M348,@M349,@M350,@M351,@M352,@M353,@M354,@M355,@M356,@M357,@M358,@M359,@M360,@M361,@M362,@M363,@M364,@M365,@M366,@M367,@M368,@M369,@M370,@M371,@M372,@M373,@M374,@M375,@M376,@M377,@M378,@M379,@M380,@M381,@M382,@M383,@M384,@M385,@M386,@M387,@M388,@M389,@M390,@M391,@M392,@M393,@M394,@M395,@M396,@M397,@M398,@M399,@M400,@M401,@M402,@M403,@M404,@M405,@M406,@M407,@M408,@M409,@M410,@M411,@M412,@M413,@M414,@M415,@M416,@M417,@M418,@M419,@M420,@M421,@M422,@M423,@M424,@M425,@M426,@M427,@M428,@M429,@M430,@M431,@M432,@M433,@M434,@M435,@M436,@M437,@M438,@M439,@M440,@M441,@M442,@M443,@M444,@M445,@M446,@M447,@M448,@M449,@M450,@M451,@M452,@M453,@M454,@M455,@M456,@M457,@M458,@M459,@M460,@M461,@M462,@M463,@M464,@M465,@M466,@M467,@M468,@M469,@M470,@M471,@M472,@M473,@M474,@M475,@M476,@M477,@M478,@M479,@M480,@M481,@M482,@M483,@M484,@M485,@M486,@M487,@M488,@M489,@M490,@M491,@M492,@M493,@M494,@M495,@M496,@M497,@M498,@M499,@M500,@M501,@M502,@M503,@M504,@M505,@M506,@M507,@M508,@M509,@M510,@M511,@M512,@M513,@M514,@M515,@M516,@M517,@M518,@M519,@M520,@M521,@M522,@M523,@M524,@M525,@M526,@M527,@M528,@M529,@M530,@M531,@M532,@M533,@M534,@M535,@M536,@M537,@M538,@M539,@M540,@M541,@M542,@M543,@M544,@M545,@M546,@M547,@M548,@M549,@M550,@M551,@M552,@M553,@M554,@M555,@M556,@M557,@M558,@M559,@M560,@M561,@M562,@M563,@M564,@M565,@M566,@M567,@M568,@M569,@M570,@M571,@M572,@M573,@M574,@M575,@M576,@M577,@M578,@M579,@M580,@M581,@M582,@M583,@M584,@M585,@M586,@M587,@M588,@M589,@M590,@M591,@M592,@M593,@M594,@M595,@M596,@M597,@M598,@M599,@M600,@M601,@M602,@M603,@M604,@M605,@M606,@M607,@M608,@M609,@M610,@M611,@M612,@M613,@M614,@M615,@M616,@M617,@M618,@M619,@M620,@M621,@M622,@M623,@M624,@M625,@M626,@M627,@M628,@M629,@M630,@M631,@M632,@M633,@M634,@M635,@M636,@M637,@M638,@M639,@M640,@M641,@M642,@M643,@M644,@M645,@M646,@M647,@M648,@M649,@M650,@M651,@M652,@M653,@M654,@M655,@M656,@M657,@M658,@M659,@M660,@M661,@M662,@M663,@M664,@M665,@M666,@M667,@M668,@M669,@M670,@M671,@M672,@M673,@M674,@M675,@M676,@M677,@M678,@M679,@M680,@M681,@M682,@M683,@M684,@M685,@M686,@M687,@M688,@M689,@M690,@M691,@M692,@M693,@M694,@M695,@M696,@M697,@M698,@M699,@M700,@M701,@M702,@M703,@M704,@M705,@M706,@M707,@M708,@M709,@M710,@M711,@M712,@M713,@M714,@M715,@M716,@M717,@M718,@M719,@M720,@M721,@M722,@M723,@M724,@M725,@M726,@M727,@M728,@M729,@M730,@M731,@M732,@M733,@M734,@M735,@M736,@M737,@M738,@M739,@M740,@M741,@M742,@M743,@M744,@M745,@M746,@M747,@M748,@M749,@M750,@M751,@M752,@M753,@M754,@M755,@M756,@M757,@M758,@M759,@M760,@M761,@M762,@M763,@M764,@M765,@M766,@M767,@M768,@M769,@M770,@M771,@M772,@M773,@M774,@M775,@M776,@M777,@M778,@M779,@M780,@M781,@M782,@M783,@M784,@M785,@M786,@M787,@M788,@M789,@M790,@M791,@M792,@M793,@M794,@M795,@M796,@M797,@M798,@M799,@M800,@M801,@M802,@M803,@M804,@M805,@M806,@M807,@M808,@M809,@M810,@M811,@M812,@M813,@M814,@M815,@M816,@M817,@M818,@M819,@M820,@M821,@M822,@M823,@M824,@M825,@M826,@M827,@M828,@M829,@M830,@M831,@M832,@M833,@M834,@M835,@M836,@M837,@M838,@M839,@M840,@M841,@M842,@M843,@M844,@M845,@M846,@M847,@M848,@M849,@M850,@M851,@M852,@M853,@M854,@M855,@M856,@M857,@M858,@M859,@M860,@M861,@M862,@M863,@M864,@M865,@M866,@M867,@M868,@M869,@M870,@M871,@M872,@M873,@M874,@M875,@M876,@M877,@M878,@M879,@M880,@M881,@M882,@M883,@M884,@M885,@M886,@M887,@M888,@M889,@M890,@M891,@M892,@M893,@M894,@M895,@M896,@M897,@M898,@M899,@M900,@M901,@M902,@M903,@M904,@M905,@M906,@M907,@M908,@M909,@M910,@M911,@M912,@M913,@M914,@M915,@M916,@M917,@M918,@M919,@M920,@M921,@M922,@M923,@M924,@M925,@M926,@M927,@M928,@M929,@M930,@M931,@M932,@M933,@M934,@M935,@M936,@M937,@M938,@M939,@M940,@M941,@M942,@M943,@M944,@M945,@M946,@M947,@M948,@M949,@M950,@M951,@M952,@M953,@M954,@M955,@M956,@M957,@M958,@M959,@M960,@M961,@M962,@M963,@M964,@M965,@M966,@M967,@M968,@M969,@M970,@M971,@M972,@M973,@M974,@M975,@M976,@M977,@M978,@M979,@M980,@M981,@M982,@M983,@M984,@M985,@M986,@M987,@M988,@M989,@M990,@M991,@M992,@M993,@M994,@M995,@M996,@M997,@M998,@M999,@M1000
30005 Today I reached 1000 subscribers on YT!! , #goodday, #thankful joy 0.926
30006 @Singaholic121 Good morning, love! Happy first day of fall. Let's make some awesome #autumnmemories #annabailey #laughter #smile joy 0.924
30007 #BridgetJonesBaby is the best thing I've seen in ages! So funny, I've missed Bridget! #love #TeamMark joy 0.922
30008 Just got back from seeing @GaryDelaney in Burslem. AMAZING!! Face still hurts from laughing so much joy 0.920
30009 @IndyMN I thought the holidays could not get any more cheerful, and then I met you. #TheNiceBot joy 0.917
30010 I'm just still . So happy .\nA blast joy 0.917
30011 It's meant to be!! #happy #happy joy 0.917
30012 0.917
30013 My morning started off amazing!! Hopefully the whole day is going as i want it to go!\n #GreatDay joy 0.917
30014 0.917
30015 @iamTinaDatta love you so much #smile 0.896
30016 @WyoWiseGuy @LivingVertical however, REI did offer me the job today as well. Can't believe how exponentially freaking joyous I feel....!!! joy 0.896
30017 2 days until #GoPackGo and 23 days until #GoGipeGo.... I'm so excited! #smiling joy 0.880
30018 @TheMandyMoore You are beyond wonderful. Your singing prowess is phenomenal but damn... I'm just elated to watch you act again. #ThisIsUs IM- joy 0.879
30019 @luckiiCHARM_ Luckii, I'm changing in so many ways bc of Him!! It's a scary but joyful feeling, making me so strong. joy 0.877
30020 @JoshNoneYaBiz I love parody accounts! Well done. Vote for #Trump. #lol #hilarious joy 0.875
30021 When you wake up from a dream laughing at something stupid, and that makes you laugh more #hilarious joy 0.875
30022 now that I have my future planned out, I feel so much happier #goals #life #happy #igotthis #yay joy 0.875
30023 Online now !!!:) all day come play with me !! I'm happy happy horny playful sweet sour;) joy 0.875
30024 @grahnot wonderful experience watching you yesterday at. @BBCLetItShine thankyou for the laughter joy 0.872
30025 @itsyourgirl_Z happy birthday :) have a blessed day love from Toronto :) #bday joy 0.868

```

```

0,joy,Just got back from seeing @GaryDelaney in Burslem. AMAZING!! Face still hurts from laughing so much #hilarious
1,joy,Oh dear an evening of absolute hilarity I don't think I have laughed so much in a long time! 🤔
2,joy,"@gardiner_love : Thank you so much, Gloria! You're so sweet, and thoughtful! You just made my day more joyful! I love you too! 🥰❤️"
3,joy,"Today I reached 1000 subscribers on YT!! , #goodday, #thankful"
4,joy,"@Singaholic121 Good morning, love! Happy first day of fall. Let's make some awesome #autumnmemories #annabailey #laughter #smile"
5,joy,"#BridgetJonesBaby is the best thing I've seen in ages! So funny, I've missed Bridget! #love #TeamMark"
6,joy,Just got back from seeing @GaryDelaney in Burslem. AMAZING!! Face still hurts from laughing so much
7,joy,"@IndyMN I thought the holidays could not get any more cheerful, and then I met you. #TheNiceBot"
8,joy,I'm just still . So happy .\nA blast
9,joy,It's meant to be!! #happy #happy You, yesterday • add code to create new datasets _
10,joy,My morning started off amazing!! Hopefully the whole day is going as i want it to go!\n #GreatDay
11,joy,👉 @cailamarsai you've had me 🥰🥰 the whole time watching @black_ishABC after you've lost your #glasses! It was #hilarious! @mrbabyboogaloo
12,joy,@iamTinaDatta love you so much #smile 🥰🥰
13,joy,"@WyoWiseGuy @LivingVertical however, REI did offer me the job today as well. Can't believe how exponentially freaking joyous I feel... !!!"
14,joy,2 days until #GoPackGo and 23 days until #GoGipeGo..... I'm so excited! #smiling
15,joy,@TheMandyMoore You are beyond wonderful. Your singing prowess is phenomenal but damn... I'm just elated to watch you act again. #ThisIsUs 🤔
16,joy,"@luckiiCHARM_ Luckii, I'm changing in so many ways bc of Him!! It's a scary but joyful feeling, making me so strong."
17,joy,@JoshNoneYaBiz I love parody accounts! Well done. Vote for #Trump. #lol #hilarious
18,joy,"When you wake up from a dream laughing at something stupid, and that makes you laugh more #hilarious"
19,joy,"now that I have my future planned out, I feel so much happier #goals #life #happy #igotthis #yay"

```

# Data Considerations

- Keep @users
  - Could be meaningless data
  - Maybe indicative of the opinion of a person (e.g. shows up on multiple angry tweets)
- Keep emojis
  - They are often ambiguous and could confuse the program
  - They may carry meaning (e.g. some emojis used more in a joyful manner)

# Data Improvements

- Use more data
- Test how much data from each emotion to use
  - Data rated from 0 to 1
  - Determine what threshold between 0 and 1 is valuable for each emotion
- Use recent data (newer than 2017)
  - Could help classify slang

# RNN Model (Keras)

- Recurrent Neural Network

- Used for sequences of data
- Many to one: sentiment classification (words -> label output)

- Same layer used over time, known as hidden state, culminates in the last hidden state which will then be classified (many to one)

- Embedding: turns positive integers into dense vectors

- Max-zero used for variable input length (i.e. varying tweet sizes)

- SimpleRNN: receives size of hidden state and passes to the RNN

- Multilayer perceptron for initial input then into classification for the 4 emotions

- Softmax used instead of sigmoid for multiple classifications but one single label

```
model = tf.keras.Sequential([  
    vectorize_layer,  
    tf.keras.layers.Embedding(  
        input_dim=max_words, output_dim=64, mask_zero=True),  
    tf.keras.layers.SimpleRNN(64),  
    tf.keras.layers.Dense(64, activation='relu'),  
    tf.keras.layers.Dense(4, activation='softmax')  
])
```

# Data Manipulation

```
# Convert strings to arrays of numbers
max_words = 1000
vectorize_layer = tf.keras.layers.TextVectorization(
    max_tokens=max_words)

vectorize_layer.adapt(x_train)
```

- Data needs to be in a format useable by the Keras model
  - Numpy arrays representing data with two dimensions
  - X = Tokenized text of each tweet
  - Y = Integer between 0-3, indicating the emotion assigned to each tweet
- Top layer of model is TextVectorization layer, which encodes text as integers
- Call to adapt() generates a vocabulary for the layer
  - Map of the 1000 most common words in the training set, sorted by # appearances in descending order
  - Vectorized text is now an array indicating how many of each vocabulary word appeared in the tweet, which is used by the rest of the model



# Training Configuration

```
model.compile(loss=tf.keras.losses.SparseCategoricalCrossentropy(),  
              optimizer=tf.keras.optimizers.Adam(1e-4), metrics=['accuracy'])  
  
model.fit(x=x_train, y=y_train, epochs=100,  
          batch_size=64, validation_data=(x_test, y_test))
```

- SparseCategoricalCrossentropy is a loss function used when there are multiple categories to choose from and they are labelled as simple integers (i.e. not one-hot encoded)
- Prediction output is formatted as a tensor containing 4 values (between 0-1) indicating how strongly the model believes the tweet shows each emotion - we then select the emotion with the highest correlation place it in that category

# Results

## Training Results:

- 100 epochs were used to train the model and the results of the training can be seen below
- 1044 total tweets in the training set and the batch size of the model is 64, so 17 steps are needed per epoch to train the model

Epoch 1/100

```
1/17 [>.....] - ETA: 15s - loss: 1.4037 - accuracy: 0.1562
7/17 [=====>.....] - ETA: 0s - loss: 1.3907 - accuracy: 0.2522
13/17 [=====>.....] - ETA: 0s - loss: 1.3857 - accuracy: 0.2644
17/17 [=====] - 1s 25ms/step - loss: 1.3854 - accuracy: 0.2637
```

Epoch 50/100

```
1/17 [>.....] - ETA: 0s - loss: 0.1843 - accuracy: 0.9531
7/17 [=====>.....] - ETA: 0s - loss: 0.1239 - accuracy: 0.9821
14/17 [=====>.....] - ETA: 0s - loss: 0.1302 - accuracy: 0.9821
17/17 [=====] - 0s 12ms/step - loss: 0.1333 - accuracy: 0.9799
```

Epoch 100/100

```
1/17 [>.....] - ETA: 0s - loss: 0.0241 - accuracy: 1.0000
8/17 [=====>.....] - ETA: 0s - loss: 0.0415 - accuracy: 0.9941
15/17 [=====>.....] - ETA: 0s - loss: 0.0456 - accuracy: 0.9917
17/17 [=====] - 0s 12ms/step - loss: 0.0443 - accuracy: 0.9914
```

# Results cont.

## Model Accuracy:

- To test the accuracy of the model, we created a small testing program to evaluate the accuracy of the already trained model on a small data set of tweets
- The tweets were tested in sets based on the specific emotion meaning we evaluated the accuracy of the model for each individual emotion separately (joy, sadness, anger, fear)
- The accuracy was calculated by taking the ratio of correct predictions in the data set to the total number of elements in the set

- Joy:

79

Accuracy: 50.63291139240506

- Anger:

79

Accuracy: 93.67088607594937

- On the data set overall:

316

Accuracy: 85.75949367088607

- Fear:

79

Accuracy: 98.73417721518987

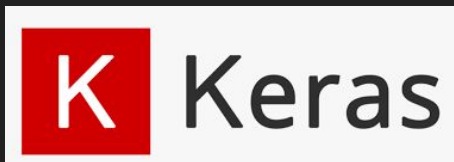
- Sadness:

79

Accuracy: 100.0

# Demo

Simple Recurrent  
Neural Network



Accuracy Testing



Web-Application



# Conclusion

- Low accuracy due to limited vocabulary and limited sentiments (4)

Example: “This rocks” → predict: **Sadness**

- Can be solved with Data Improvements (larger samples, recent data, more sentiments)
- Add a “neutral” class for tweets that fall outside our emotion set.
- Other considerations: early stopping and data augmentation

Questions?